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Decision in the Great Lamp Case.

JUST as we are going to press the Circuit Court of Appeals renders its decision in the now famous Edison lamp suit. The full text of the decision of Judges Lacombe and Shipman, who sat in the case, is given in a special supplement in this number. It will be remembered that Judge Wallace, sitting in the U. S. Circuit Court, handed down early in July, 1891, a decision in this case—the Edison Electric Light Company vs. the United States Electric Lighting Company—which ordered a decree for an injunction and an accounting. The case was carried up on appeal to Judges Shipman and Lacombe, with the result announced in the present decision, in which the decision of the lower court is sustained with costs. As we said of the former decision so may we say of this one: "Its general import is a strong affirmation of the claims of Mr. Edison to the invention of the practical incandescent lamp." Judge Wallace's decision will be found in full in THE ELECTRICAL WORLD of July 18, 1891.

Huge Electric Lighting Displays.

THE coming week will witness in New York City what will doubtless be the most elaborate display ever made of both stationary and portable decorative effects produced through the agency of the electric light. October 10, 11 and 12 have been set aside as the three days during which New York will celebrate the 400th anniversary of the discovery of America by Christopher Columbus, and arrangements are being made of the most extensive and elaborate nature for exhibiting in an appropriate way the progress made in the arts and industries on the American Continent during the last 100 years. A gigantic parade on the night of October 12 will be the most striking feature of the whole programme. In this parade a number of floats—drawn by horses, of course,—will be arranged to show the century's progress, each being designed to exhibit the present condition of some one art or industry. As might be expected, the electric light will be the predominating feature of this parade. The floats will be lighted by electricity from storage batteries carried upon the cars themselves, one of which, it is said, will carry no less than three tons of batteries. In addition to this display made on the moving vehicles in the parade a large number of stationary exhibits will also be shown. Some of these will be similar to those recently seen in St. Louis, where some of the most elaborate and striking effects yet produced were brought out.

Fire Risks and Rules.

THE recent articles in our columns on fire risks and underwriters' rules have awakened an interest in Europe, and the discussion in the columns of an English contemporary, to which we referred in our issue of Sept. 24, has been continued by the editor and Mr. Binswanger. The latter gentleman returns to his attack on American fittings, and at last gives some details. He states that American porcelain is inferior in insulating qualities to china made in English potteries, and that surface leakage due to this and the method of fixing screws and covering them with substances like shellac as well as exposing the "working parts" of the fittings to the atmosphere is of common occurrence. He also finds vulcanized fibre used in cut-outs, holders and switches, which strengthens our suspicion that Mr. Binswanger has formed his opinion of American fittings from types now obsolete. The inferiority of our insulated wires is settled by a singular argument, as follows: "As regards the insulation of cables and wires, the very multiplicity of them proves that our transatlantic friends are very much at sea over this question." If Mr. Binswanger can demonstrate that American porcelain is inferior to English, or that its insulating properties are insufficient for the purposes for which it is used he will have the satisfaction of knowing that he has directed keen American competition, always seeking for new channels in which to divert itself, to this subject and that the fault will quickly be remedied. We do not think Mr. Binswanger means to do American manufacturers injustice, but wholesale condemnation of wires on the grounds he gives is certainly unjust. The discussion in regard to the English Underwriters' rules turns upon their ambiguity and frequent alterations, two points that will receive proper attention, we trust, from the gentlemen now at work on our new code.

The Trolley in New York.

IT now seems probable that the trolley, which has been so bitterly denounced by the daily press, and charged with all sorts of death-dealing powers, is to make its way into the very heart of New York City. The action of the Board of Aldermen in granting franchises to the Metropolitan Traction Company, which permit the use of the trolley system, while it may appear hasty, is certainly to be commended. It is unjust that the opposition of the press and the ignorance and prejudice of a few should prevent the introduction and development of a system of rapid transit that is so essential to the comfort and convenience of the general public, and which has proved to be such a success elsewhere. President Crimmins states that the trolley will only be used on the lines which follow the elevated railway, that is on the route from the Battery to 110th street under the Sixth and Ninth Avenue elevated roads. With the trolley attached to the elevated structure the last objection to this system has been removed, for it can neither disfigure the street nor prove a source of danger either to human life or the destruction of property. The attitude of several of the leading New York dailies toward the trolley system is simply absurd. The accidents which occur on trolley lines are, without exception, due to rapid transit, and not in any way to the motive power, and statistics prove conclusively that even in this respect it is less dangerous than the cable. Other large cities, such as Boston, Cleveland and Brooklyn, have not only adopted it, but are constantly extending the system into the most crowded portions of the city, and there is no reason why New York should be so backward in this respect. We hope that at last the trolley system has been given an opportunity to vindicate its right in this city to the place it holds elsewhere among the systems of rapid transit.

Educated Guides for the World's Fair.

THE new Chicago University, of which Prof. Harper is president, opened its doors during the past week to 500 students. It may not be generally known among our readers that the buildings of this new institution are in close proximity to the World's Fair Grounds, a location admirably suited to the proposed use of the Fair as a gigantic museum, through which university instructors will conduct classes from the various branches of the institution. It is announced that the university authorities have under consideration a plan to form such classes for systematically studying the World's Fair exhibits. Students in these classes will have the benefit of the knowledge and experience of the members of the faculty. It is intended to have those who wish to take this course of University extension, as it has been termed, go to the college in the morning, hear a lecture or be put through a recitation on some important division of the Fair, and in the afternoon and evening receive a practical demonstration of the facts they have learned by visiting the exhibits themselves. The scheme strikes us as an eminently practical one, and is capable of very extended and general application to all departments of the Fair. It might be found a good investment for some enterprising capitalist to obtain the right to furnish specialists to act as guides in those departments of the Fair in which apparatus, machinery or processes were shown with which they were familiar. For instance, a certain number of young men might be obtained who were well acquainted with the construction of electrical apparatus whose services could be secured for a reasonable sum by a small party, desiring to obtain an intelligent idea of the various exhibits in the Electricity Building. Such opportunities to secure the most information concerning the thousands of exhibits in the least possible time ought to be appreciated by the better class of visitors.

Use of the Telegraph.

ACCORDING to some statistics recently published by the British government the use of the telegraph is increasing very rapidly in all European countries as well as in the United States. Very few people are aware of the intimate connection which now exists between this method of transmitting intelligence and the commercial as well as the domestic life of all civilized peoples. In the publication referred to figures are given showing the total number of messages carried as well as the proportion per head of population for the years 1870, 1875, 1880 and the four years ending with 1890. According to the statistics the United Kingdom led all the other nations of the world, both at the beginning and end of the period under consideration, in regard to the number of messages carried as well as the proportion per head of population. It is shown that in 1890 the total number of messages carried and the messages per capita were greater in every country mentioned than in 1870, the rate of increase varying, however, with different countries. This was greatest in the case of France, where the messages per head of population rose from .1 in 1870 to .7 in 1887, and was next greatest in Great Britain, where it rose from .3 in 1870 to 1.8 in 1890. Norway showed the lowest increase, namely, from .4 in 1870 to .7 in 1890. The figures given for the United States show an increase from .2 in 1870 to .9 in 1890. This, it must be remembered, however, is based upon the figures of the Western Union Telegraph Company only, which, while it does the larger portion of the telegraphic business of the United States, does not by any means give the aggregate of messages transmitted during the year. It is interesting to notice that in 1870 Switzerland, Holland, Belgium and Norway all stood higher in the list as regards the proportion per head of population than either the United States or Great Britain. As mentioned above, Great Britain in 1890 was higher in the list than all other countries, both as regards number of messages carried and the proportion of messages per head of population. The number of messages per capita was 1.8 in the United Kingdom, in Switzerland 1.2, United States, Holland and Belgium, .9 each; then following in the order named, France, Norway, Denmark, Germany, Austria, Sweden, Italy, Hungary, Spain and Russia. In the last named country the statistics show that the proportion per head of population was only .1 in 1887.

The "Drehstrom" Patent.

BY NIKOLA TESLA.

In the last issue of THE ELECTRICAL WORLD I find an article on my "Drehstrom" patent which appeared originally in *Industries*, and is, I believe, from the pen of the able editor of that journal. Some of the statements made are such as to cause an erroneous opinion to gain ground, which I deem it my duty to prevent—a disagreeable one I may say, as I do not like to express my opinion on a patent, especially if it is my own.

It may be, as the writer states, that the theory of the action of my motor advanced in my paper before the American Institute in May, 1888, is a clumsy one, but this theory was formed by me a number of years before the practical results were announced, the patents being applied for only after it was undoubtedly demonstrated that the motor could fairly compete in efficiency with the direct current motor, and that the invention was one of commercial value. These patents were taken out with the help of some of the ablest attorneys in the United States, well versed in electrical matters; the specifications were drawn up with great care, in view of the importance of the invention, and with proper regard to the state of the art at that period, and had the patents been carefully studied by others there would not have been various features of my system reinvented, and several inventors would have been spared at this late date a keen disappointment.

The writer apprehends that it might be difficult for a non-technical judge to decide whether a motor with two or more separate fields and armatures, coupled together mechanically, does or does not fall under my patent. I do not share his apprehension. Judges are highly educated men, and it does not require much technical knowledge to convince one that it is the same whether two belts driving a rigid arbor are close together or far apart. Nor do I think that it is necessary for the honorable judge to be a partisan of the armature reaction theory in order to recognize the identity of the two arrangements referred to by the writer of the article in question. Indeed, I would seriously doubt the sincerity of a man capable of clear conceptions were he to uphold that the arrangements are essentially different, even if the case should stand exactly as he assumes by way of illustration of "puzzles likely to arise." For where is there a difference? Take, for instance, a form of my two-phase motor There are two sets of field magnets, one at the *neutral* parts of the other. One of the sets, therefore, might as well be removed and placed a distance sideways, but long experience shows that in output, efficiency, cost of construction and in general mechanical respects such an arrangement is inferior. The two sets are connected inductively through the armature body or the windings thereon. Part of the period one set of field magnets acts as a generator, setting up induction currents, which circulate in the field of force of the other set, which may be looked upon as a motor. Part of the period again, the second set becomes the generator and the first the motor, the action being at the same time such that the generated currents are always passed in a definite direction with respect to the field; they are commutated as it were, and a tendency to rotate in a given direction is imparted to the armature. Now place two fields side by side and connect properly the armature windings. Are not the fields again inductively connected? Do not the currents set up by one field cause currents to circulate in the other, and is the action not exactly the same in both cases? This is a fact, no matter what theory is adhered to. The writer says that in the case of two separate structures there is really nothing which may be called rotation of the field. But is there any such thing, when the two structures are merged in one? Is it not in accordance with accepted notions to conceive the imaginary lines as surging simply in the pole projections in exactly the same manner in both the arrangements? Irrespective of the view taken, be it even the more unfair to the inventor, no one is permitted to go so far as to make him responsible, in such a case, for theories and interpretations of his invention. Theories may come and go, but the motor works, a practical result is achieved and the art is advanced through his pains and efforts. But what I desire to point out principally is that in the article above referred to the writer is only assuming a case which cannot occur. He is evidently judging the state of things from my short paper before the American Institute. This paper was written in a hurry, in fact only shortly before the meeting of the Institute, and I was unable to do full justice even to those features upon which, as employé of a company owning the invention, I was permitted to dwell. Allow me to observe that my patent specification was written up more carefully than my paper and the view taken in it is a broader and truer one. While the "clumsy" theory was adapted as the best in explanation of the action of the motor, the invention is *not* represented as dependent entirely on that theory; and in showing a three phase motor with six projections, where it was manifestly more consistent with the accepted popular ideas to assume the "lines of force" as simply surging in the projecting pole pieces, this view was distinctly and advisedly taken, as the following quotation from my foundation patent will show: "The variations in the strength and intensity of the currents transmitted through these circuits (lines and armature) and traversing the coils of the motor produce a steadily progressive shifting of the *resultant attractive force* exerted by the poles upon the armature and consequently keep the armature rapidly rotating." There is, in this instance, no question of a rotating field in the common acceptance of the term of the *resultant attractive force:* there is a question simply of a diagram of force, and it is immaterial for the operation whether the fields are close together or far apart, or even whether, or not, they are inductively connected.

I do not think that in Germany, where the Patent Office is proverbially strict in upholding the rights of the inventor, an illegitimate and unfair appropriation of the invention by others will be tolerated by the courts.

Meeting of the American Institute of Electrical Engineers.

The American Institute of Electrical Engineers held its first meeting after the summer holidays at its rooms at 12 West Thirty-first street on Sept. 27, 1892. The meeting was called to order by President F. J. Sprague. The paper of the evening was "On the Law of Hysteresis, Part II.," by Chas. P. Steinmetz, which was listened to with great interest. The discussion of the paper was participated in by Messrs. Kennelly, Stanley, Emery and others. The report of the committee on revision of the rules regarding the election of officers, which was published in full in THE ELECTRICAL WORLD of Sept. 24, 1892, was adopted. The following were elected associate members of the Institute:

H. Fleetwood Albright, Western Electric Company, Chicago, Ill; Charles G. Armstrong, Chicago, Ill.; Romaine Callender, Brantford Electrical Laboratory, Brantford, Canada; Chester D. Crandall, Western Electric Company, Chicago, Ill.; George E. Fisher, Commercial Electric Company, Detroit, Mich.; Charles Flesch, Melbourne, Australia; J. P. Jackson, assistant professor of electrical engineering, Penn. State College; Frank E. Kinsman, Plainfield, N. J.; Jas. P. Magenis, editor the Adams *Freeman*, Adams, Mass.; Carl K. MacFadden, Chicago & Northwestern Railway Company, Chicago, Ill.; James McBride, New York & Boston Dye Wood Company, Brooklyn, N. Y.; Augustus Noll, New York Insulated Wire Company, New York City; Wm. D. Ray, Northern Pacific Railroad Company, Chicago, Ill.; Howard S. Rodgers, Thomson-Houston Electric Company, Lynn, Mass.; Robert A. Ross, Edison General Electric Company, Petersborough, Ont.; Frank Stuart Smith, Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.

The Manufacture of Carbons at Nuremberg.

The French Vice-Consul at Nuremberg, M. Leon Duplessis, has recently made a lengthy report on the electric carbon industry of that town, from which the following extracts are taken:

"The manufacture of electric light carbons occupies six large factories, belonging respectively to C. Conradty, Ch. Shmelzer, Carl Braun, J. G. Meier, Emile Mahla, and Jules Fuchs. To these may perhaps be added a seventh, namely, that of Dr. Albert Lessing, though the latter does not produce carbons for electric lighting, but only battery carbons.

"The raw material employed in this manufacture is 'retort graphite.' As far as the Vice-Consul was able to discover, this material only is used when homogeneous carbons are required; but when cored carbons are to be made a softer substance is added. Before they are ready for use homogeneous carbons pass through twelve, and cored carbons through sixteen, different processes. The first operation is to break the graphite into small nuts. For this purpose a three-stamp mill is used. The stamps in falling crush the graphite placed over movable steel gratings that allow the broken material to pass between their bars. These bars are placed nearer to one another, or further apart, according to the size of the pieces required. Having passed this grating the pieces are collected by hand and passed through a sieve. The coarse particles are submitted to a vertical crushing, and the fine are passed on to a rolling mill. The vertical crushing is intended to reduce the pieces of graphite to about the size of semolina grains. The graphite thus treated is directed a second time into a sifting machine. Then follows more rolling. The sixth operation is to damp and mix the graphite obtained from the rolling mill, as well as the powder gathered in the sifting machines, with a binding substance. The mass delivered from this machine being too soft, it is necessary to render it plastic and capable of taking a shape, and with this object it is consigned to a sort of puddling machine which produces a species of paste. This paste is pressed through a machine fitted with dies. These produce coarse rods or other pencils, according to the diameter of the cylinders. The rods so prepared are introduced into steel hydraulic cylinders and submitted to a pressure of about 25 atmospheres. Some of these hydraulic presses—the construction of which the Nuremberg manufacturers have only attained by successive steps—can deliver 500 metres of carbon per hour or from 2,000 to 3,000 arc light carbons of average size. All these operations terminated, the carbons obtained are baked in a blast furnace where the temperature occasionally attains as much as 2,000° centigrade. When homogeneous carbons are withdrawn from the furnace they have only to be passed on to an automatic cutting machine. This machine is in direct communication with a ventilator which draws off the powdered carbon produced in cutting.

"The construction of machines employed in the manufacture of electric light carbons is also a Nuremberg specialty, and the house of Justus-Christian Braun has a monopoly of the business, and supplies machines in Europe and America. The cost of an outfit for a factory is put at 20,435 marks, irrespective of packing, transport, and customs charges."

Electricity and the World's Fair.

LITERATURE on the World's Fair has been reasonably copious, but the following information with regard to the Electricity Building, extracted from an article on "Architecture at the World's Columbian Exposition," by Henry Van Brunt, in *The Century*, will be of interest:

"The north front, toward the picturesque lagoon, being, by its position, relieved to a certain extent from strict conformity to the classical ideal, seemed to invite a greater freedom of treatment than was admissible elsewhere. Here, therefore, the order of the façades, after passing the point of demarcation furnished by the corner pavilions, is made to sweep around two apsidal projections, 115 feet in diameter, between which is recessed the north porch, composed of two towers, similar to those of the east and west porches, flanking a broad, central pavilion, pierced with a great arched window, corresponding with the arch lines of the steel trusses in the long nave, and divided by transoms and mullions. The sky line between these towers is made horizontal, and the spandrel panels of the arch are occupied by gigantic reclining figures typifying Investigation and Discovery. The porch is formed by the Ionic order of façades, which is extended between the apses in the form of an arcade of five arches supporting a wide terrace or balcony.

"Up to this point, for the reasons stated, the design of the Electricity Building is characterized by an emphasis of vertical expression unusual in academical architecture, the sky line being fretted by 10 campaniles, varying in height from 154 to 190 feet, and by the four square intermediate domes, which mark the position of the posterns. But, on the south front, it was necessary to make a concession to that spirit of grandeur and ceremony which should prevail

PORCH OF THE ELECTRICITY BUILDING, SHOWING POSITION OF THE FRANKLIN STATUE.

around the great court of the Exposition. Accordingly, the vertical line, predominant elsewhere in the building as a foil to its long, low, horizontal mass, is here subordinate to the spirit of repose. To this end the campaniles on the corners are set back from the front, but connected with it by gabled pavilions, 23 feet wide, and the principal entrance of the building on this side is treated as a triumphal arch, 60 feet wide and 92 feet high, of which the archivolt springs from the main cornice, as an impost, the jambs being formed of coupled full columns of the main order with corresponding pilasters. This arch is crowned with a classic pediment containing an escutcheon, which bears the electromagnet as a symbol of electricity, and is supported on each side by a female figure representing the two principal industries connected with this science—electric lighting and the telegraph. Above, in contrast with the somewhat fantastic movement of the sky lines elsewhere, rises a solid elevated attic, forming a severe horizontal outline against the sky. This central mass is buttressed on each side by great consoles, supporting emblematic statues and resting on pedestals, continuous with the clearstory of the nave, and embellished with medallions of Morse and Vail, the American discoverers of the electric telegraph. The most famous and most cherished association of America with the history of the science of electricity is the discovery of the electric properties of lightning by Franklin. The architects determined, therefore, that a statue of the patriot-philosopher should stand under this great arch, and that to him the main porch on the court should be dedicated. This work was intrusted to the Danish-American sculptor, Mr. Carl Rohl Smith, whose conception of the subject is happily realized in a spirited figure, 15 feet high, representing Franklin as the philosopher, with the historic kite and key, observing the storm clouds. This noble statue is elevated on a high pedestal in

the centre of the porch, and behind and over it is formed a colossal niche, of which the triumphal arch is the frame, covered with a half dome or conch, divided by ribs and profusely enriched with bas reliefs, recalling, in general aspect, the much admired hemicycle or belvedere in the court of the Vatican palace, and, in detail, the characteristic stucco embellishments in the vaults of Villa Madama. Around its curved walls is carried the great order of the building, with grouped pilasters. On the main frieze of this niche is written the famous epigram of Turgot in honor of Franklin: Eripuit cœlo fulmen sceptrumque tyrannis.

"In the five bays of the niche are the main doorways, three of which, in the back, open into the central nave; the other two, toward the front, give access to an open ambulatory or portico, which forms the first story of the court frontage of the building. To this portico the subordinate Ionic order of the façades is arranged to form a screen, with two detached columns in each bay. Upon the frieze of this order, where it occurs in the hemicycle, appear the names of the most famous deceased Americans connected with electricity: Henry, Morse, Franklin, Page and Davenport; while outside, upon the same frieze in alphabetical order all around the building, are the names of 66 great electricians of all ages and countries, whose names have passed into history. The fame of living electricians must rest upon their displays within the structure.

"So far as practicable, the decorations of this building are devised to suggest its uses. the conventional embellishments of the orders being varied to the frequent recurrence of the electromagnet and lamp, and the recesses of the hemicycle and porticos being enriched with color. It is intended also to illuminate and emblazon the architectural features at night with an electric display of unprecedented interest and magnitude.

"The architectural modeling of this building was done under a contract with the Phillipson Decorative Company of Chicago, the sculpture of the main pediment being from the hand of Mr. Richard Bock, of Chicago."

Another description of the Electricity Building which is of interest appeared recently in the New York *World*, from which we have taken the following brief extract:

"Being smaller than either of the other structures around the main plaza, its designers seem to have thought that it should be more self-assertive in outline, and that verticality should be strongly emphasized. One cannot think the idea mistaken, but one wishes it had been somewhat differently carried out. There is no central dome, and the roofs cross at right angles after the manner of the roofs, nave and transept in a cathedral which has no central tower or *flèche*. Yet the outline of the building is very much broken. The porch, which forms the middle feature toward the plaza, rises far above the main roofs, with a lofty open portal in its centre marking the height of the ceilings beyond it; above this a pediment, and then a great plain attic. The angle pavilions are unsymmetrically treated with gables of different sizes, and from each springs a turret with open sides and a small conical dome. Similar turrets and domes flank the entrance pavilion toward the canal, with a windowed story and a gable between them, and below a projecting columned porch, and the entrance toward the lagoon is treated in still another equally elaborate way. Moreover, each of the arcaded longer walls between the central and the angle pavilions is divided half way by a broad, solid pier, which, carried up above the roofs and finished with a domical roof, makes the effect of an intermediate pavilion. The walls themselves show two stories, included in the round-arched arcade, the lower openings being divided, rather unfortunately, by a single column in the middle of each. In so diversified a structure some breaking of these openings was doubtless desirable, but if each had been cut into three instead of two parts, it seems as though the effect would have been better. A single supporting member in the axis of a large opening is not conventionally correct, I think, and there is usually a good artistic reason for architectural conventions of which many generations of great builders have approved. Nor is the composition of the pavilions as successful as it is in the neighboring structures, nor are the outlines of the turrets either very dignified or very graceful.

"It should be remembered, however, that the standard by which these great Fair buildings must be judged is very high. So lofty a degree of excellence has been achieved in some of them that work which is even a little less good incites to criticism. Had this Electricity Building stood, for instance, in the grounds of the Philadelphia Exhibition it would have seemed a very distinct and remarkable success.

"In treatment it is less nearly classic, more decidedly Renaissance, than either of the others we have seen, and Corinthian, Ionic and composite orders are all introduced into the design, while a modern and appropriate character is given the details by the constant introduction of electrical tools and symbols. Some of this purely architectural ornamentation is very good, but, once more, the figure

BENJAMIN FRANKLIN STATUE FOR THE PORCH OF THE ELECTRICITY BUILDING.

sculpture does not promise to be as fine as one would like to see it. Under the vast archway in the portal which faces the court, and which admits to a great semi-circular porch with a domical ceiling, will stand a statue of Benjamin Franklin, 15 feet in height, and mounted on a lofty pedestal. The station is a superb one, and the subject is unsurpassed, among all American subjects, for historical interest and dramatic suggestiveness."

Two big search lights which will be used to illuminate the grounds next summer have arrived on the World's Fair grounds, and will probably be used for the dedicatory exercises. These great lamps weigh respectively 2,200 and 1,300 pounds.

The work of lighting the Administration building has finally been approved. On the ground floor eight standards will be set up, each about 18 feet high and carrying 50 incandescent lamps. In each of the four entrances to the building will be two clusters of 25 lights. Within, at the level of the mezzanine floor, about 85 feet from the ground floor, is the rotunda gallery. In each alternate post of this gallery there will be a seven light standard. On the cornice, about 130 feet from the floor and just at the base of the dome a circle of about 1,400 lights has been placed, arranged in rosettes. Just above the false dome, in the space between it and the dome proper, a dozen arc lamps have been located. Their position is such that they illuminate the interior of the dome proper from behind the false dome in such a manner as to best reveal the beauty of its decoration. The light is shed through the false dome by reflection, the lamps being out of sight. The effect is one of diffusion rather than of the usual brilliancy. All told, 8,700 lights will be used in the building.

The C. & C. Electric Motor Company, of New York City, has received an order from the Chief of Construction of the World's Fair for two generators of 110 h. p. each, to be used to furnish current to the electric elevators that have been installed in the Administration Building. These machines are to be in operation during the dedication ceremonies of the new building this month. In addition to these machines the same company has also received orders for five more generators of the same size, four of which are to furnish power to motors operated by exhibitors and the fifth is for furnishing lighting current.

Ewing's Magnetic Curve Tracer.

This instrument has been already described in THE ELECTRICAL WORLD of Aug. 20, 1892. Some additional information concerning its working, however, is found in a letter addressed by Prof. Ewing to *The Electrician*, of London, in which he says:

"You refer to me as having 'repudiated any mechanical inertia,' but it should be understood that I was then speaking of certain phenomena which presented themselves when the cycle of magnetization was gone through so slowly that no effects of mechanical inertia could have been sensible. At high speeds the effects of inertia are, of course, felt, and appropriate means must be taken to avoid them.

The case is similar to the familiar one of a steam engine indicator. To adapt the indicator to high speed working, we reduce to the utmost the mass of the moving parts and use a stiff spring. To adapt the magnetic curve tracer to high speeds we use a light mirror and tighten or shorten the stretched wires. In both cases we have to be content with a comparatively small diagram as a result of the stiffer spring or the tighter wire. In both cases ripples due to the free vibration of the working parts are liable to be superposed on the main cycle of movement, and to keep these within bounds it is essential that the period of free vibration should be many times less than the period of the main cycle.

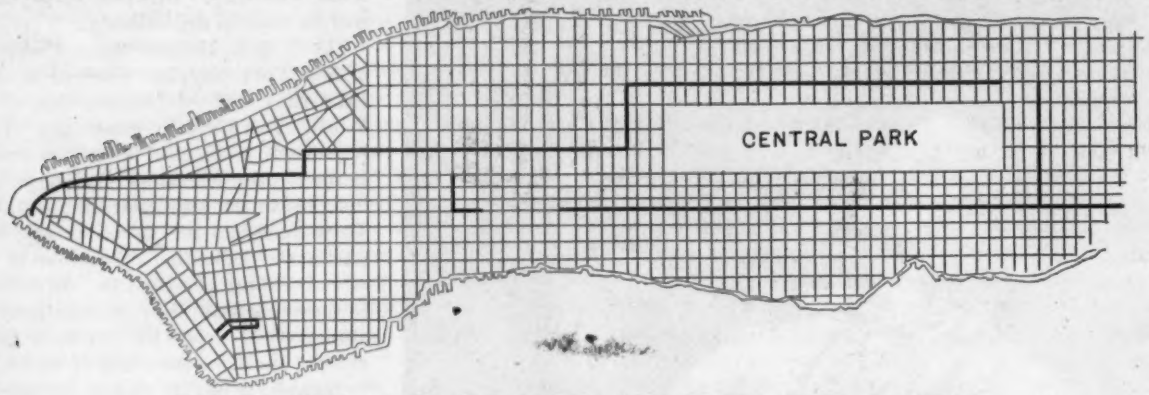
"In reply to Prof. Perry's question, I named 20 cycles per second as a limit of speed within which the instrument exhibited had given a perfectly satisfactory B·H curve. To secure a good diagram at this speed the wires have to be somewhat tightly stretched, but not so tightly as to prevent the diagram from being fairly large. No doubt, with shorter and tighter wires and a lighter mirror, still higher speeds are practicable; but experiments in this direction have still to be made. For very high speeds I think it may be found best to use two mirrors, each having one component of motion, with successive reflection of the light from both.

"In the chief use of the instrument, namely, the magnetic testing of samples of iron or steel, the cycle is gone through at so comparatively slow a rate that the mechanical inertia of the working parts is absolutely without influence. Using a revolving commutator of the type employed in my lecture, which gives gradual variation of the current from positive to negative and back, or from zero to any value, the observer will turn this slowly enough to follow with a pencil the movement of the spot of light over the curve. A much higher speed than is possible in this operation would still be so slow as to escape all disturbance from mechanical inertia.

The Granting of Extensive Street Railway Franchises in New York City.

The most important franchises since that of the famous Broadway franchise of 1884 were granted by the Board of Alderman on Thursday of last week. While there was little doubt but that these privileges would eventually be given, the action of the Board occasioned some surprise. The Metropolitan Traction Company or the Houston, West Street and Pavonia Ferry Railroad Company—for although these are legally distinct corporations they are practically one—has secured valuable extensions of its street railway lines, but the most interesting feature is the right to employ the trolley system.

The accompanying map best shows the route of the proposed lines. President Crimmins states that the company



MAP SHOWING LINES FOR WHICH FRANCHISES WERE GRANTED.

does not intend to use the trolley on all the lines for which franchises have been obtained, but that it will undoubtedly be employed for a rapid transit line from the Battery to 110th street, following for the greater part of the way the Sixth and Ninth Avenue Elevated Railway. The trolley wire will be attached to the elevated structure if the consent of the Manhattan Elevated Railway Company can be obtained, but if not, ornamental poles will be erected close to the supports of the present structure.

Before any active steps toward construction can be taken it will be necessary to obtain the consent of the Railroad Commissioners, the Board of Electrical Control and a majority of the property owners along the route. It is stated that the consent of a majority of property holders on Ninth avenue above Fifty-third street has already been obtained.

A number of sites near or on the proposed lines have recently been purchased by the Metropolitan Traction Company, which are probably intended for the location of power houses. The following are the routes covered by the franchises and the proposed connections:

From Twenty-third street and Broadway along Twenty-third street to Lexington avenue; up Lexington avenue to Twenty-seventh street, to connect with a line from Thirty-fifth street to Twenty-seventh street on Lexington avenue, in order to give the Broadway railroad direct lines to the Grand Central Station and Thirty-fourth Street Ferry; an extension of the Lexington avenue line to Ninety-eighth street and to the Harlem River, with an extension on 116th street to Morningside Park; to connect the Chambers Street and the Grand Street Ferry railroads by branches beginning at the intersection of Third street and Avenue C, through Avenue C to and across Houston street, and thence by single track through Pitt street across Stanton street to Delancey and Pitt streets; to connect the Sixth and Ninth avenue roads through West Fifty-third street; to join the Broadway line at South Fifth avenue and Broome street by an extension from Canal street and West Broadway, and thence across Canal street to South Fifth avenue, through the latter street to Broome street; to connect the Metropolitan Cross-town Railway by a line from Spring street and South Fifth avenue to Canal street and West Broadway, and thence along Broome street to Sullivan street, to Watts street, to the Houston, West Street, and Pavonia Ferry Company on West street, and to connect also with the Desbrosses Street Ferry line; to connect the Pavonia Ferry Company with the Chambers street road at Houston street and Avenue C, and to extend the Ninth avenue line from West Sixty-fourth street to 110th street.

The Killing of Sixteen Dogs by Lightning.

The accompanying illustration shows the kennel yard of the Brooklyn Gun Club at Smithtown, L. I., where lived

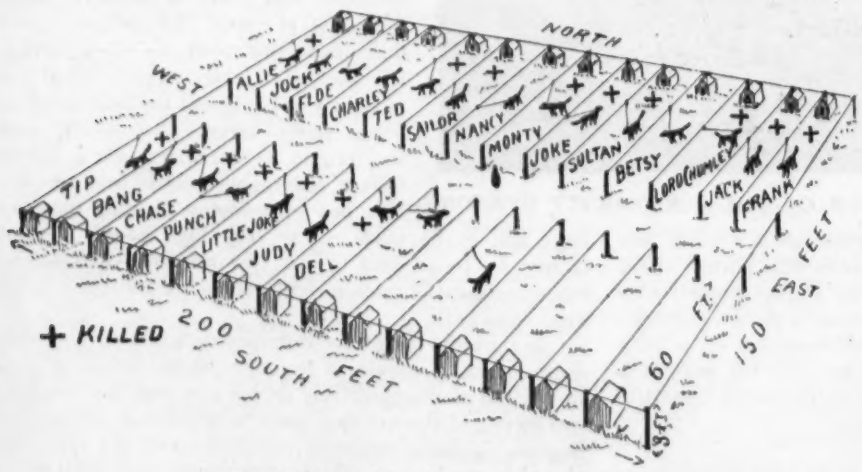


DIAGRAM OF THE DOG KENNELS.

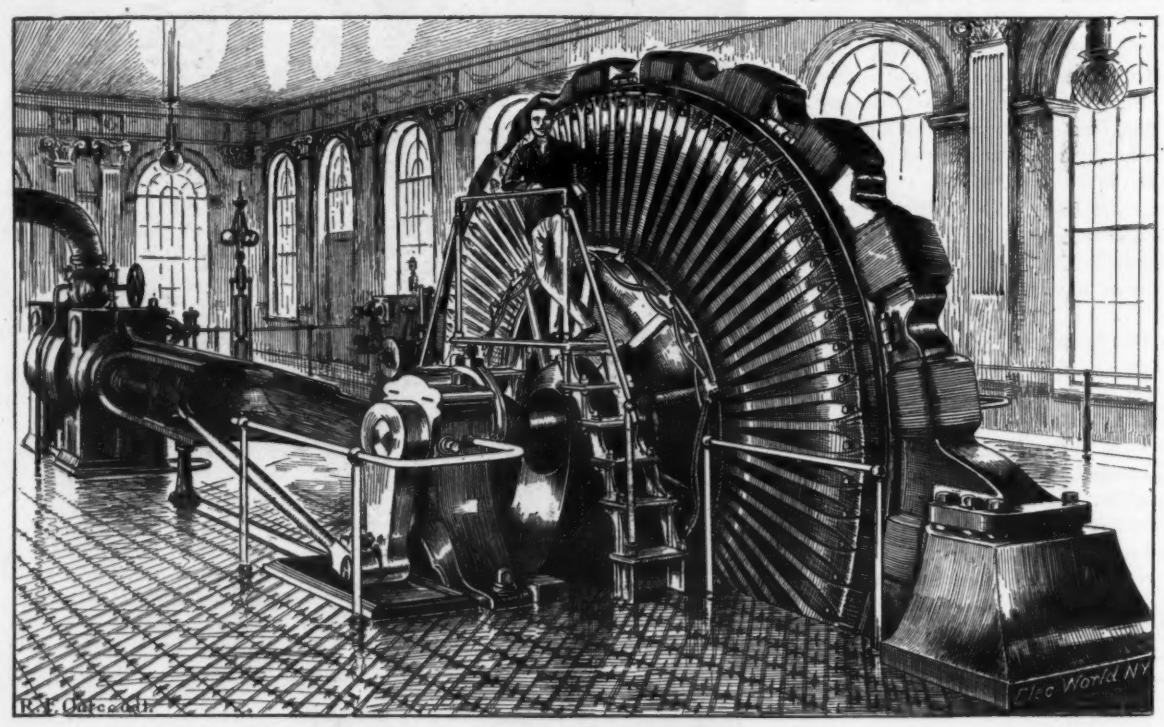
the sixteen dogs, belonging to members of the club, which were killed by lightning on Saturday night of last week.

The yard was laid out about a year ago, and is about 200 × 150 feet, the longest dimension being east and west. It was inclosed by ordinary telegraph wire, fastened to posts about three feet from the ground. At every sixteen feet along the wire was a post. To every post was attached a telegraph wire which, as is shown in the cut, extended sixty feet into the yard, where it was fastened to a second post. This wire was about three feet from the ground.

A steel chain four feet long was attached to each wire by a large ring, which slipped easily along the wire. A smaller metal ring at the other end of the chain slipped into the leather collars which all the dogs wore. Each dog had a separate wire and a separate kennel house, as is shown in the cut.

On Saturday night, during the heavy storm, the twenty-three dogs which were in the yard crawled into their kennels. Early on Sunday morning the keeper found seven dogs on the south side of the yard dead in their kennels. All the dogs were in natural positions, some curled up and others with their heads extended and their noses stretched out on their paws. Their eyes were closed and they seemed not to have been awakened by the lightning. Their faces were not drawn up and from appearances the dogs seemed to have suffered no pain. The skin, and in some cases the flesh on their necks, where the metal ring touched their collars and their necks, was slightly burned.

The lightning seemed to pass along the wire, which inclosed the field, to the dogs on the north side of the yard, where it killed Frank and Jack and Lord Chumley, a valuable prize Irish setter. Then it missed Betsey, but burned her neck. Then it passed along, killing five more of the dogs. Keeper Downer carefully examined both the wire which incloses the field and also the wires to which the dogs' chains were attached, but could find no traces of the lightning on any of the wires. The kennels were not burned, and the wooden posts to which the main wire was fastened showed no signs of the passing of the lightning. Our cut is from the New York *Sun*.



A 500-H. P. MULTIPOLAR GENERATOR.

A 500-Horse Power Generator.

An excellent illustration of European practice in the use of large direct coupled dynamos is shown in the accompanying illustration, which represents a machine recently installed in the arsenal of Herstal, Belgium, where it generates power for distribution about the factory.

This dynamo is a multipolar machine consisting of a fixed field and an armature of the Gramme type, which is of rather extraordinary dimensions. The field magnets form a sort of crown, composed of 10 pieces firmly bolted together, and are excited by a shunt winding. There are 20 polar projections embracing the armature and leaving an interval of only six millimetres, which is necessary for the rotation of the armature. The different parts of the field are first assembled and bolted, and then they are raised in order to leave room for the construction of the armature, whose dimensions necessitate its being built up in position. When the armature is completed the field is fixed definitely in place.

The armature is 15 feet 9 inches in diameter. Its core is composed of sheets of iron .27 inch in thickness, insulated with paper and placed together so as to obtain a width of 16 inches. Their depth in the direction of the radius is 5.2 inches. This mass of iron forms at the same time the fly wheel, possessing sufficient inertia to insure perfect steadiness. The sheets of iron are not held in position by mere pressure alone, but are secured by bolts and cross pieces. Both bolts and cross pieces are, of course, carefully insulated.

The conductor on the armature is a copper strip 4 × 5 millimetres, insulated with cotton and shellac. Upon the exterior circumference there is only one layer of wires, but on the interior the wire is placed in two layers. The entire armature contains 2,400 turns and carries two commutators, which alternately make contact with successive coils. In order to facilitate the work of setting up and of renewal, the coils are made to gauge. The upper end of one core and the lower of the following on the same side of the armature are soldered together to a bar of copper which conducts the current to the corresponding bar of the commutator. The commutators are 2.5 metres in diameter. The armature is protected against the action of centrifugal force by bands of phosphor-bronze 1.5 millimetres in diameter.

Eighty metallic brushes, arranged so that they can be raised or lowered simultaneously, receive the current from the two commutators. The position of the brushes is regulated by a device which acts upon them all at the same time, so that it is a very simple matter to handle them. Upon each side of the armature passing over the shaft is a pair of steps, which make it possible to examine the brushes in case of necessity.

The current, which amounts to 2,440 amperes at a tension of 125 volts, is conducted to the switchboard by four underground cables. The intensity of the current circulating respectively in the armature conductor and the field conductor is 1,935 and 1,032 amperes per square inch.

The choice of a metal for the field magnets was not arrived at until after numerous tests. Wrought iron was too expensive, and cast iron did not present a satisfactory magnetic quality. Extra soft steel, from the Angleur Steel Works, was finally decided upon; its magnetic permeability was found equal to that of commercial soft iron, and it could be cast.

The weight of the steel shaft is 10 tons, that of the iron of the armature alone 6 tons. The weight of the copper upon the fields is 4,400 lbs., and that of the copper on the armature is 1,340 lbs.

The most interesting feature about this dynamo is its direct connection to a steam engine, and the employment of the armature as a fly wheel and the results obtained have been most gratifying, the dynamo running as smoothly and evenly as if it were belted in the ordinary manner to an engine with a heavy fly wheel.

The dynamo is driven by a compound condensing engine at a speed of 166 revoltions per minute, which gives a velocity at the periphery of about 16.75 metres per second. The total efficiency is about 90%.

Cooking by Electricity.

The large engineering firm of Crompton & Co., Limited, of London, Eng., is making extraordinary efforts to push various electric heating apparatus. It is the intention to introduce electricity as the sole cooking power in several large flats now nearing completion in the West End of London, where it was intended to install gas stoves.

Chronological History of Electricity—Part II.—1800–1820.

BY P. F. MOTTELAY.

HOMPSON (Sir Benjamin), Count Rumford, an eminent scientist, native of Woburn in Massachusetts, Kut., F. R. S., one of the founders of the English Royal Institution, publishes "Philosophical Memoirs . . . being a collection of . . . Experimental Investigations . . . of Natural Philosophy."

Though more properly identified with important observations and researches on heat, the question of the nature of which, Dr. Edward L. Youmans says, he was the first to take out of the domain of metaphysics, where it had stood since the days of Aristotle, he has given accounts of some very important experiments regarding the relative intensities and the chemical properties of light, heat and electricity, which can be seen at pages 273, etc., vol. lxxvi., part ii., of the *Phil. Trans.* for 1786. It is known that heat spreads in every direction, whereas the electrical fluid may be arrested in its progress by certain bodies, which have on that account been called non-conductors, but he shows that the Torricellian vacuum, on the contrary, affords a ready passage to the electrical fluid while it is a bad conductor of heat.

At page 30 of George E. Ellis' "Memoir of Sir Benjamin Thompson," published in Boston (no date), is reproduced Rumford's "Account of what expense I have been at toward getting an electrical machine" during 1771, and at pages 350, 351, vol. iii., of the "Complete Works of Count Rumford," published by the American Academy of Sciences, allusion is made to the galvanic influence in the construction of utensils.[1]

A. D. 1802.——Pepys (William Haseldine, Sr.), son of an English manufacturer of surgical instruments, who became F. R. S. and was one of the founders of the Askesian Society, of the London Institution, and of the London Geological Society, constructs, during the month of February, 1802, the strongest pile hitherto known. It consists of sixty pairs of zinc and copper plates, each six feet square, held in two large troughs filled with 32 pounds of water containing two pounds of azotic, or nitric, acid.

With this battery he succeeded in melting iron wires ranging in diameter from one two-hundreth to one-tenth of an inch, the combustion developing an extremely bright light, while platinum wires, one thirty-second of an inch in diameter, turned to white heat and melted in globules at the point of contact. Charcoal was permanently ignited a length of nearly two inches and the galvanic action was strong enough to light it after passing through a circuit of 16 persons holding one another by the hand. Gold leaf displayed a bright white light, accompanied with smoke; silver leaf gave an intense green light without sparks, but still more smoke; while sheets of lead burned actively, with accompaniment of very red sparks mixed with the flame.[2]

Later on, another battery was constructed by him for the London Institution. This consisted of 400 pairs of plates five inches square, and of 40 pairs one foot square. With it, Davy ignited cotton, sulphur, resin, oil and ether, melted a platinum wire, burned several inches of an iron wire one three-hundreth of an inch in diameter, and boiled easily such liquids as oil and water, even decomposing and transforming them into gases. It was during the year 1808 that Pepys finished the enormous battery of 2,000 double plates already alluded to under the Cruikshanks (A. D. 1800) and the Davy (A. D. 1801) articles, and which is to be found described at page 110 of the "Elements of Chemical Philosophy."

One year before that (1807) Pepys constructed a new form of eudiometer, of which a description was given before the Royal Society on the 4th of June, as shown at page 270, vol. i., of the "Abstracts of Papers, etc.," of that institution, as well as in the 1807 volume of the *Philosophical Transactions*.

Of the many ingenious experiments by which Mr. Pepys distinguished himself, none scarcely attracted more attention than those which are referred to in the last named *Transactions* for 1866, pp. 339–439. It is only since 1815, when he employed the electric current to heat iron wire and diamond dust together, whereby he obtained steel, that the direct carburization of iron by the diamond has been clearly established. Prior to this date Clouet had, in 1798, melted a little crucible of iron weighing 57.8 grammes containing a diamond weighing 0.907 gramme and obtained a fused mass of steel. Guyton de Morveau reported upon Clouet's experiment in the *Annales de Chimie* for 1799 (vol. xxxi., p. 328) and his investigations were repeated by many scientists, notably by Margueritte, as recently as 1865. The latter's observations, which were communicated to the *Annales de Chimie et de Physique* (tome vi.) showed that, although carburization can be effected by simple contact of carbon and iron in a gaseous atmosphere, it is nevertheless true that in the ordinary process of cementation the carbonic oxide gas plays an important part, which had until then been overlooked.[3]

Sir Humphry Davy employed in his experiments on the decomposition and composition of the fixed alkalies two mercurial gasometers of Mr. Pepys' design, described in No. 14 of the *Phil. Trans.* for 1807, in conjunction with the same apparatus used by Messrs. Allen and Pepys for the combustion of the diamond.[4]

During the year 1822 Pepys constructed a very large spiral galvanic battery for electromagnetic experiments, which was put together for the London Institution closely on the plan of the one first built upon an effective scale by Dr. Robert Hare, Professor of Chemistry in the University of Pennsylvania. He called it a *calorimotor*, by reason of its remarkable power of producing heat, and Pepys' arrangement is well illustrated in the "Encyclopædia Britannica" article on "Voltaic Electricity." It consists of but two metallic sheets, copper and zinc, 50 to 60 feet long by 2 feet wide, coiled around a cylinder of wood and prevented from coming together by three ropes of horse hair, the whole being suspended over a tub of acid so that, by a pulley or otherwise, it can be immersed or taken up. As stated in vol v. of the *Trans. of the Amer. Phil. Soc.*, this battery required about fifty-five gallons of fluid, and the solution used contained about one-fortieth of strong nitrous acid.

When, as Noad observes, it is stated that a piece of platinum wire may be heated to redness by a pair of plates only four inches long and two broad, the calorific power of such an arrangement as the above may be imagined to have been immense. The energy of the simple circle depends on the size of the plates, the intensity of the chemical action on the oxidizable metal, the rapidity of its oxidation, and the speedy removal of the oxide. Mr. Pouillot is said to have constructed one of these batteries with twelve couples for the Paris Faculté des Sciences, and found it very powerful in producing large quantities of electricity with low tension. The best liquid for this battery was water with one-fortieth in volume of sulphuric acid

SIR BENJAMIN THOMPSON (COUNT RUMFORD).

and one-sixtieth of nitric acid. With the above described battery of Mr. Pepys, Sir Humphry Davy performed a remarkable experiment which is to be found described in the *Phil. Trans.* for 1823. A similar apparatus was produced at about the same time, but quite independently, by Dr. Seebeck, of Berlin.

Another of Mr. Pepys' inventions is the substitution, for the tin-foil coatings within the glass of Bennet's electroscope, of two plates, forming an acute angle, which, by a regulating screw, can be adjusted to any required distance from the gold leaves. The angular part is secured to the bottom; the open part perpendicularly upward. By this ingenious mode of approximating the coatings to the gold leaves, the resistance being diminished, a weaker intensity of electricity suffices for their disturbances.[5]

A. D. 1803 ——Geoffroy Saint-Hilaire (Etienne), a very eminent French naturalist, once the pupil of Hauy, whose life he was the means of saving during the massacre of September, 1792, is the first to give a complete description of the electrical organs and functions of the *raia torpedo*, of the *gymnotus electricus*, of the *silurus electricus*, and of other similar species of fishes. His work on the subject, entitled "Sur l'anatomie comparée, etc," is alluded to in vol. i., an XI., No. 5, of the "Annales du Museum," whence it is translated for the fifteenth volume of the *Phil. Mag.*

His analyzation of the fluid in the cells of the *torpedo* showed it to consist of albumen and gelatine; and, what is very curious, he discovered organs analogous to those of the *torpedo* in different species of the same genus *raia*, which do not appear possessed of any electrical power.

The electrical organs of the *silurus electricus* he found to be much less complicated than those of other electrical fishes. They lie immediately below the skin and stretch all around the body of the animal. Their substance, he says, is a verticulated mass, the meshes of which are plainly visible, and these cells are filled, like those of other electrical fishes, with an albuminous gelatinous matter. The nerves distributed over the electrical organs proceed from the brain, and the two nerves of the eighth pair have a direction and nature peculiar to this species.[6]

In his great work on Egypt (Pl. xii., 2) Geoffroy gives the figure of a *malapterus electricus* (see Adanson, A. D. 1751) which is opened to show the viscera, but, by a singular inaccuracy, says Mr. James Wilson, the fish is represented as scaly, whereas there are no scales whatever upon this fish and no fish known to possess electric powers has either scales or spines.[7]

Geoffroy Saint-Hilaire (Isidore), son of Etienne, was also a distinguished naturalist. He became assistant professor or zoölogy to his father in 1829, likewise his assistant at the Faculté des Sciences in 1837, and, when Etienne became blind, during the year 1841, he succeeded to the professorship of zoölogy at the Museum of Natural History. He is the author of "The Life, Works and Theories (*Vie, Travaux et Doctrine*) of Etienne Geoffroy Saint-Hilaire," Paris, 1847.[8]

A. D. 1803.——Carpue (J. C. S.), English scientist, relates, in his "Introduction . . . and Galvanism," published in London, some noteworthy experiments on the curative action of common electricity.

He repeated many of the investigations of Giovanni Aldini and, in the presence of Dr. Pearson and other medical gentlemen, experimented upon the body of Michael Carney, immediately after his execution for murder. Carpue's main object was to ascertain whether galvanism, applied at once to the nerves, could excite action in the internal parts, and especially those subservient to respiration. He first made an opening into the windpipe and, after about three pints of oxygen were thrown into the lungs, he applied conductors to the phrenic nerve as well as to other parts of the body, the lungs being at the same time occasionally inflated, but no action could be excited in the diaphragm. The application of conductors to the inside of the nostrils and elsewhere excited very considerable contractions in the right auricle more than three hours after death, the ventricles being, as in Aldini's experiments, perfectly motionless.[9]

A. D. 1803.——Hachette (Jean Nicholas Pierre), a protégé of Monge, who became professor at the French Ecole Polytechnique, where he had among his pupils Poisson, Arago and Fresnel, presents to the Institut National the dry pile which was the result of the many experiments he had carried on in conjunction with Mr. Charles Bernard Desormes, who was then known as a prominent French scientist and manufacturer of chemical products.

Their idea was to simplify the construction of the voltaic column, or rather to establish the development of electricity by simple contact. They sought to obtain a substance which would satisfactorily replace the wet discs, and not be affected by the metals, as had been all the liquids hitherto employed.[10] After numerous investigations they adopted a compound consisting of common starch and either salts, varnishes or gums, with which they made the necessary discs. These were dried and placed alternately between the copper and zinc couples, but were afterward found to be too easily affected by moisture to prove very effective.[11]

In the colums of the *Annales de Chimie*, named below, will be found detailed the numerous experiments with the galvanic pile carried on individually and collectively by Hachette, Desormes and other scientists; those of Hachette and Thénard upon the ignition of metallic wires claiming especial attention. Prof. John Farrar[12] calls attention to the latter and in the Phil. Mag. for 1821 will be found an account of the researches of the above named scientists made during the year 1805, to establish more properly the analogy between galvanism and magnetism. Hachette and Desormes endeavored to ascertain the direction which would be taken by a voltaic pile, whose poles were not joined, when freely suspended horizontally. Their pile, as Fahie quotes it, was composed of 1,480 thin plates of copper tinned with zinc, of the diameter of a five-franc piece, and was placed upon a boat which floated on the water of a large vat; but it assumed no determinate direction, although a magnetized steel bar, of a weight nearly equal to that of the pile, and placed like it upon the boat, would turn, after some oscillations, into the magnetic meridian.[13]

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[1] See Sir W. Thomson "Mathematical and Physical Papers," London, 1890, vol. iii., pp. 123, 124; *Phil. Mag* vol. ix., for 1801, p. 315; Silliman's *American Journal of Science*, vol xxxiii., p. 21; "Biog. Universelle," tom e xxxvii., p. 51.

[2] Figuier, "Exposition, etc.," Paris, 1857 vol. iv., p. 347.

[3] Translation of Prof. W. C. Roberts-Austen, F. R. S. For Mr. Children's investigations in the same line, see the *Phil. Trans.* for 1815, p. 370, also A. D. 1809.

[4] See "Bakerian Lectures," London, 1840, pp. 84 and 93.

[5] See *Quarterly Journal of Science*, vol. i., for 1816; *Phil. Mag.*, vol. xxi., p. 241; xlii., p. 15; Becquerel, vol. i., p. 34. Mr. William H. Pepys, Jr., published descriptions of the newly invented galvanometer and of the large galvanic apparatus in the *Phil. Mag.*, vol. x., June, 1801, p. 373, and vol. xv., for 1803, p. 94.

[6] Consult C. Matteucci, "Traité des Phénomènes . . ." Paris, 1844, chaps. vi and vii., pp. 301–327.

[7] See Gilbert's *Annalen*, xiv., 397; *Bulletin Soc. Phil.*, No. 70; Geo. Wilson's "Life of Cavendish," London, 1851, p. 469, alluding to the later experiments on electrical fishes made by Faraday (1838), Dr. James Stark, of Edinburgh (1841), Prof. Goodsir (1845), and Dr. C. Robin (1846). Consult, also, *Journal de Physique*, vol. lvi., p. 242, and the complete list of Geoffroy's works in Callisen's "Medicinisches-Schriftsteller Lexicon."

[8] See "Memoir of M. Isidore G. Saint Hilaire," by Mr. De Gastrefages, in "Report of Smithsonian Institution" for 1872, pp. 384–394.

[9] See "Galvanic Experiments Made by Carpue on the Body of Michael Carney, etc.," London, 1804, *Phil. Mag.*, vol. xviii., p. 90; the "Encyclopedia Metropolitana," article "Galvanism," vol. iv., pp. 105, 106, also the "Introduction, etc.," above named for descriptions of Mr. Cuthbertson's plate electrical machine and of Mr. Read's condenser.

[10] H. Boissier, "Mémoire, etc.," Paris, 1801.

[11] D. Tommasi, "Traité des Piles Electriques," Paris, 1889, p. 529.

[12] "Elem. of Elec. Magn., etc.," Cambridge, 1826, p. 167.

[13] See *Annales de Chimie*, vol. xxxvii., pp. 281–321; xliv., pp. 267–284; xlvii. (Biot's observations), p. 13; xlix., pp. 45–54, and xiv. for 1808. See, also, the *Annales* for 1834, as well as vol. xli., p. 125, for experiments of MM. Desormes and Clément on the fixed alkalies; *Journal de Physique* of Sept., 1821, for the paper of Hachette and Ampère on the electromagnetic experiments of Oersted and Ampère; *Annales de Chimie et de Physique*, vol. ii., for May, 1816, pp. 76–79, and v., p. 191; *Phil. Mag.*, vol. lvii., p. 43; L. W. Gilbert, *Annalen der Physik*, vol. ix., pp. 18–39; xvii., pp. 411–427, *Journal de l'Ecole Polytechnique*, vol. iv., for 1802; xi., p. 284; Leithead, "Electricity," p. 252; *Bull. de la Soc. Philomathique*, No. 83; P. Sue, aîné, "Hist du Galv.," Paris, an X., 1812, vol. ii., pp. 160, 167, 188, 345 (Hachette et Thénard) and p. 371; Joseph Izarn, "Manuel du Galvanisme," an XII., 1804, sec. iv., p. 179; Poggendorff, vol. i., pp. 562, 965; Larousse, "Dict. Universel," vol. vi., p. 576; "Royal Society Catalogue of Scientific Papers," vol. iii., pp. 106–109.

The Efficiency of Transformers at Different Frequencies.—I.*

BY W. E. AYRTON AND W. E. SUMPNER.

Some years ago Mr. Mordey published in the *Journal of the Institution of Electrical Engineers* the results of some experiments which appear to show that, when a transformer of the Mordey type of construction was working at a given load, the waste of power was less at a frequency of 100 than at a higher or lower frequency. In 1888, to test this point, experiments were carried out at the Central Institution by Messrs. Lamb, Smith and Woods, the power put into and taken out of a Mordey type of transformer being measured by the electrometer method, and it was for the purpose of these tests that there was constructed the large non-inductive resistance that was described by Mr. Mather and one of us before the Physical Society last year.

But, although this method is theoretically one of the best for ascertaining the power given by any current to any circuit, the percentage error in measuring the efficiency is, of course, the percentage error in measuring the power put into or taken out of the transformer. And, as it is very difficult to avoid making errors of one or two per cent. with the electrometer method, it is almost impossible to be sure of changes of this magnitude in the efficiency produced by a variation in the frequency.

Subsequently, tests were made by others of the students, employing other methods for measuring the power, but it was not until one of us had devised the method that appeared this year in the technical press for measuring directly the losses in a transformer that we felt in a position to express an opinion regarding the actual effect produced by variation of frequency on the efficiency of a transfomer.

Except under the special circumstances, to be subsequently referred to, this method requires for its employment two transformers similar in type and output, and a third transformer, which may be of much smaller output, for supplying the energy lost in the coils of the two large transformers.

The detailed working of the method will be understood on reference to Fig. 1. The fine wire coils of the two transformers A, B, are connected in parallel through the high pressure switches s s. The thick coil of A is connected directly with the mains, while the thick coil of B has one of its ends joined with one of the mains, and the other in series with a dynamometer D, a switch S_2, the current coil of the wattmeter W_1, the secondary of the subsidiary transformer C, and finally with the other main lead. A switch S_1 is placed in one of the mains, as indicated in the figure, so that the current supplied directly from the mains can be switched off when desired. The primary of transformer C is connected with the mains through an adjustable resistance, R_2 and a switch S_2. A wattmeter W_2 has its current coil joined up so as to be traversed by the current entering the parallel circuit formed by the primaries A and B, and its pressure coil placed in series with the non-inductive resistance R_2 across the mains. The pressure coil of the other wattmeter W_1 is connected in series with the non-inductive resistance R_1 across the secondary of the auxiliary transformer C.

If the switches S_1, S_2 be closed, the currents flowing are merely the magnetizing currents required for the transformers A and B, and W_2 merely measures the open circuit losses. Unless the secondary of C be short circuited no current will flow through the thick coil of B, for the magnetizing current is then supplied by the thin coil after transformation by A. If now switch S_2 be closed, so that the secondary of C supplies a P. D. of say 6 volts to the circuit formed by the thick coils of A and B, large currents will flow through the transformers. The P. D. between the terminals of A will be, of course, the voltage of the mains, for example 100; but the P. D. at terminals of B will be either 106 volts or 94 volts, according as the 6 volts supplied by the secondary of C are in opposite phase, or in the same phase as the 100 volts between the mains. Indeed, if there were considerable magnetic leakage in the transformer C, or if R_2 were a highly inductive resistance, the P. D. of the 6 volts supplied by C would be out of phase with the voltage on the mains, and the P. D. at the terminals of B might be anything between 106 and 94 volts.

If there be a P. D. of 106 volts between the terminals of B this transformer is being used as a step-up transformer and A is converting downward. If, however, there be only 96 volts between the terminals of B, it is A which is working as the step-up transformer, and B which is converting downward. In the majority of the cases to be subsequently described the 6 volts supplied by C were sufficient to drive the full load currents through the transformers.

The load W we take as being measured by the product of the current indicated by D and the P. D. supplied to the primary of the step-up transformer. If A is used for converting upward this load is simply 100 times the current in ampères, whereas if B is used as the step-up transformer the power returned to the mains by A is 100 times the current in ampères, and if to this we add the two power losses measured by W_1 and W_2 we obtain the power taken from the mains and supplied to the primary of B. If W be the load in watts supplied to the step-up transformer, if w_1 and w_2 be the watts at this load measures by W_1 and W_2 respectively, and if λ be at the same time the loss of power in the leads used in joining up the transformers, in the coils of the dynamometer D and in the current coil of W_1 the total loss in the two transformers is

$$w = w_1 + w_2 - \lambda$$

and the efficiency of the double conversion is

$$\eta = 1 - \frac{w}{W}$$

The advantage of this method of determining efficiency, as pointed out some years ago by Dr. Hopkinson in connection with a similar method of measuring the efficiency of dynamos and motors, is that a small error in determining either w or W will make practically no difference in the calculated value of η. For instance, as the value of η for two transformers is about 90 per cent., w is about one-tenth part of W, and it follows that an error of ten per cent. in estimating the ratio w/W only affects η to one per cent., and only affects the calculated efficiency of each transformer to one-half per cent.

It would have been more accurate had we placed the dynamometer D in circuit with the thick coil of A rather than with the thick coil of B, but the currents in the coils of A and B for closed magnetic circuit transformers differ to such a slight extent that either current may be approximately taken to represent the load without introducing any appreciable error in the determination of the efficiency.

The instruments used were of a rough character, and no special care was taken with them; for our object was rather

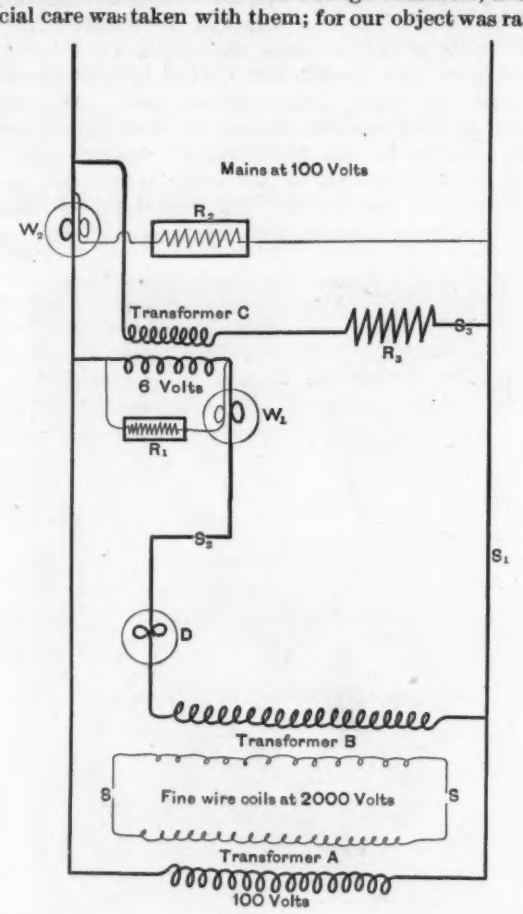


FIG. 1.

to see how far measurements made by this method with common instruments could be relied upon than to obtain the most accurate results possible.

D (see Fig. 1) is an ordinary Siemens dynamometer measuring up to 55 ampères for one revolution of the pointer when the thick coil is in circuit.

W_2 is a Ganz wattmeter, supplied, as usual, with two non-inductive resistances. In the following experiments its sensibility was such that one revolution of the pointer corresponded with about 1,200 watts.

W_1 is a Siemens dynamometer as made commercially, but modified so as to form a wattmeter by connecting the mercury cups forming the ends of the movable coil with two separate terminals. This swinging coil was used in series with a suitable non-inductive resistance R_1 as the pressure coil of the wattmeter, one of the fixed coils being traversed by the main current. When large currents were flowing through the thick coils of A and B a current of 8 or 10 ampères often passed through the volt coil of this wattmeter, and its attached resistance R_1, but although the power so wasted was quite appreciable, consideration of Fig. 1 will show that the reading of the wattmeter W_2 is not affected by it in the least, and that it thus does not enter into the calculation of the efficiency.

An ordinary Cardew voltmeter was used for the adjustment of the potential on the mains.

The transformers tested were:

M_1, M_2. Two transformers of the Mordey type, each of output 4.5 kilowatts, converting from 2,000 volts to 100 volts (or 50 volts). They are numbered 1,874 and 1,872. We shall for brevity allude to them respectively as M_1 and M_2.

M_3. One transformer of the Mordey type of output 3 kilowatts, converting from 2,000 volts to 100 volts (or 50 volts). Its number is 1,832, and in what follows it is alluded to as M_3.

M_4. One transformer of the Mordey type of output 1.5 kilowatts, converting from 100 volts to 100 volts. It has three coils, each of the same number of turns, and occupying spaces proportional to the numbers 1, 1, and 2, respectively. The transformer was wound in this way for experimental purposes, but in other respects it does not differ in construction from the ordinary type made by the Brush Company in 1887. It is alluded to in the following experiments as M_4.

H. One hedgehog transformer, made by Swinburne & Co., of output 4 kilowatts, converting from 2,000 volts to 100 volts. It is referred to by the letter H.

A small transformer of change ratio 6 to 1 was occasionally used as the subsidiary transformer C. It was not, however, of any recognized commercial type, and the magnitude of its efficiency does not enter into the tests.

The losses in the leads were carefully determined, and confirmed by measurement made with different methods. The same leads and instruments were used in all the experiments. The first method of testing was to measure the resistances of the different coils and leads and calculate the losses at the currents used.

These measurements were confirmed by passing steady currents of 30 and 40 ampères (measured by a standard d'Arsonval galvanometer used as an ammeter in shunt to a platinoid strip) through the leads, and measuring with the aid of a standard voltmeter (a second d'Arsonval galvanometer used in series with known resistances) the power lost in the leads for these currents. The same experiment served to calibrate the dynamometer D. The wattmeters W_1 and W_2 had been previously calibrated by means of the same two standard instruments. The measurements were made when both the thin and the thick coils of the dynamometer D and the wattmeter W_1 were in circuit, since in the actual transformer tests it was occasionally found necessary to change these coils. The measurements of the losses in the instruments and leads were further confirmed by tests with alternate currents of the same frequencies as those used in the measurements, and it will be apparent that one of the advantages of the method of testing the efficiency of transformers which we have employed arises from the fact that the apparatus required for the efficiency measurements can be used for determining the losses in the leads, etc., without any alteration of the connections. For if the switch S be open and switches S_2 and S_3 be closed and the primaries of the transformers A and B are short circuited, the reading of the wattmeter W_1 will at once measure the losses occurring in the testing apparatus itself when any special current (measured by D) is passing through it.

The measurements made by these different methods were in quite satisfactory accordance with each other. With a current of 40 ampères the loss in the leads, when the thick coils of D and W_1 were used, was 55 watts. When the thin coil of D was substituted for the thick coil the extra loss at 40 ampères was 70 watts, and an equal increase in the loss was caused by using the thin coil of W_2 instead of the thick coil.

The losses occurring in the coils of the transformers can be measured independently of the other losses by simply leaving the switch S_1 open and taking the reading of W_1 for different alternating currents flowing through D. The two transformers A and B are so connected that a P. D. of a few volts will cause large currents to flow through the thick coils when the switches s s in the secondary circuit are closed. Of course the iron cores are magnetized slightly and a certain amount of energy is absorbed by hysteresis, but this is quite negligible compared with that lost in the copper. For at most the voltage corresponding with the induction of the core is only that needed for driving the currents through the resistance of the transformer coils. This is only about one per cent. of the ordinary voltage of the transformers, and as the losses in the iron vary as the square of the induction density (more accurately as $B^{1.6}$), the core losses are only 0.01×0.01, *i. e.*, 0.0001 of the normal losses occurring in the use of the transformer.

It thus becomes possible to investigate the very important matter of the variation of the core losses under different conditions of load. All that need be done is to determine:

1. The total losses occurring in core, coils and testing apparatus for different currents when S_1 is closed; and

2. The total losses in the coils and testing apparatus for the same currents when S_1 is open. The difference between the losses found for any particular current is the loss in the core for that particular load.

It was pointed out in the article in the technical press already referred to that the reading of W_2 practically gave the losses in the two transformers, and that W_1 gave the losses caused by the heating effect of the currents in the coils, etc. The measurements made with closed circuit transformers have entirely confirmed this view.

Thus for the two 4½ kilowatt transformers of the Mordey type (M_1 and M_2) tested at 100 volts and a frequency of 160, the reading of W gradually changed from 220 watts on open circuit to 230 watts at a load of 2,500 watts, and to 235 watts at a load of 5,000 watts. Whereas the core losses, as determined by the subtraction method, were 220 watts on open circuit, 220 watts at a load of 2,500 watts, and 227 watts at a load of 5,000 watts, or practically the same as the watts as measured by W_2. In another test at a frequency of 150 the reading of W_2 changed from 210 watts on open circuit to 222 watts at a load of 4,000 watts, the iron losses, as calculated by the difference method, diminishing gradually from 210 watts on open circuit to 200 watts at a load of 4,000 watts.

In another test at the same frequency the reading of W_2 altered from 215 watts on open circuit to 210 watts at full load while the iron losses were found exactly the same as the corresponding readings of W_2 up to a load of 3,000 watts; afterward, however, the iron losses were slightly greater. In a test at a frequency of about 100 the reading

*Read at the meeting of the British Association, Aug. 5, 1892.

of W_2 decreased from 260 watts to 250 watts as the load increased up to 4,000 watts, the iron losses being the same up to a load of 2,500 watts and being slightly less afterward and equal to 280 watts at a load of 4,000 watts. In a later test at a frequency of 100 the reading of W_2 only changed from 285 watts to 290 watts from open circuit to a full load of 5,000 watts, while the iron losses diminished under the same circumstances from 285 watts to 275 watts.

In all these experiments numerous tests at intermediate loads were taken, and the general smoothness of the curves obtained by plotting the observations is such as to justify considerable confidence in the character of the results. The slight differences between the curves denoting the readings of W_2 and those representing the iron losses are sometimes in one direction and sometimes in the other, and are to be regarded as an indication of the extent of the experimental error to which the measurements are subject rather than as any certain evidence of alteration of the core losses with the load. In fact the experiments seem to show that with closed circuit transformers at any rate the core losses are practically constant at all loads. This conclusion is only what theory indicates, but it has frequently been doubted, as many published efficiency tests of transformers have indicated that the core losses diminish as the load increases.

This constancy of the iron losses is further evidenced by tests made with the other two Mordey transformers. Thus, in testing the combination of the 4,000-watt Mordey (M_1) with the 3,000-watt Mordey (M_3), this iron loss at a frequency of 160 only altered from 185 watts at no load to 175 watts at a 4,200-watt load. In another test at a frequency of 200 the core losses changed from 170 watts at no load to 155 watts at a load of 4,200 watts. In a test of the 1,500-watt Mordey M_4, the iron losses at a frequency of 160 were found constant within one per cent., while the load changed from 0 to 3,000 watts, or double full load.

When the open magnetic circuit transformer was used the measurements were not so satisfactory. Two or three reasons may be assigned for this. Owing to the large magnetizing current the reading of the dynamometer D cannot be taken to indicate the current in the thick coil of A as well as that in the thick coil of B. Also owing to the great difference in the regulation of the hedgehog transformer when converting up or down, the voltage on the transformer C had to be considerably greater than in the previous tests, when the full load currents were flowing, and, consequently, while one of the transformers A, B is worked at the proper voltage, the other is worked at a voltage considerably different from 100. The curves obtained are sometimes of a curious character, and we have not yet had time to fully explain them. As we hope to repeat these tests, we prefer to postpone the publication of the results referring to the core losses of open circuit transformers. Our experiments, however, indicate that the iron losses do not alter by as much as 10 per cent. when the load is increased from 0 to full load.

(To be continued.)

The Voltage of the Arc: A Suggestion.

BY J. R. CRAVATH.

In a former article* I gave the results of some experiments on the hissing of the electric arc. I did not then attempt to explain the fall of voltage in the hissing arc. I gave reasons for supposing that the hissing was due to the sudden heating of comparatively cool carbon to the boiling point.

It has occurred to me since that this same cause might be made to account for the fall of voltage in the transition from the normal to the hissing arc

May it not be that the constant change in position of the positive evaporating surface and the constant heating of cool carbon to high temperature has in some way a "dampening" effect and so prevents the consumption of energy and causes a drop in the voltage at the point where hissing begins? At least the crater is the centre of energy.

Messrs. Cross & Shepard in a paper before the American Academy in 1886 showed that the cooling of the positive carbon resulted in a great fall of potential and great hissing and unsteadiness. This would seem to point in the same way.

This is only advanced as a suggestion based on the facts as they seem at present, and future research may prove it wrong. The writer has himself had no opportunity to investigate the matter properly.

*"Normal and Hissing Arcs," THE ELECTRICAL WORLD, March 19, 1892.

Elementary Electrical Instruction.

The practical applications of electricity are now so numerous that many of the young men in our large cities are looking about for instruction along this line. In New York City the only institution we know of that is at present giving a regular evening course of instruction in the elementary branches of electricity is the Young Mens' Institute at 222-224 Bowery. Here an effort is being made to teach young men both the theory and practice of electricity and to place these opportunities within the reach of every young man in the city who desires to obtain such information. A practical course has been arranged in addition to the usual course in the mechanic arts. Two evenings in the week will be devoted to the work under a competent instructor. Incandescent lighting, arc lighting, the telegraph and telephone, will be discussed in an elementary way, and general information given concerning other subjects. Mr. H. A. Benedict, a graduate of Cornell University, in the electrical engineering course, will conduct the class, which is expected to be very large. The special opening of this class will be on Oct. 3.

Further Experiments on the Specific Inductive Capacity of Electrolytes.

BY EDWARD B. ROSA, PH. D., PROFESSOR IN WESLEYAN UNIVERSITY.*

1. In a note appended to an article on the "Specific Inductive Capacity of Electrolytes," in the *Philosophical Magazine* for March, 1891, I referred briefly to some experiments then under way on the behavior of glass in a non-uniform electrical field in different liquids. The experiments were undertaken with a view of verifying the results of previous work, which indicated that water and alcohol possess genuine specific inductive capacities much larger than most other liquids, although not infinite as sometimes stated.

The energy of an electric system is

$$W = \frac{1}{8\pi}\int\int\int K H^2\, dv.$$

Supposing the media isotropic, and the system to consist of a solid dielectric immersed in a fluid, we may write,

$$W = \frac{K}{8\pi}\int\int\int H^2\, dv + \frac{K_1}{8\pi}\int\int\int H_1^2 dv,$$

where the first integral is to be taken throughout the fluid and the second throughout the solid. If $K_1 > K$ the force in the fluid near the solid is increased, while within the solid it is decreased, as compared with the forces in the absence of the solid. The total energy is, however, increased by the presence of the solid, and if the fluid is variable the solid is acted upon by a resultant force which urges it toward the stronger parts of the field. If, however, $K_1 < K$ the solid tends to move toward those regions where the electric force is less. This is analogous to the case of magnetic and diamagnetic bodies in a magnetic field.

These considerations lead one to expect that glass (for example) would go toward the stronger parts of the field in air, turpentine and other dielectrics having a small value of K, and toward the weaker regions of the field in water and alcohol. Moreover, since K for water and alcohol is very large, the glass would experience a force many times greater in water in the one direction than in air in the other. These anticipations have been completely realized.

THE ELECTRICAL FIELD.

II. In order to obtain an electrical field in which the intensity of the electric force varies in a known manner, I chose the case of two parallel wires oppositely charged.

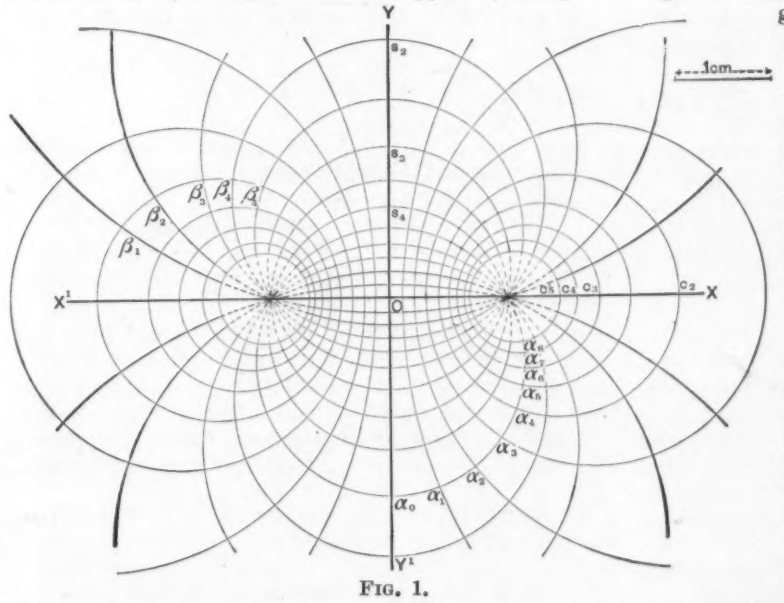


FIG. 1.

As is well known, the equipotential surfaces and tubes of force are in this case circular cylinders intersecting orthogonally. A section perpendicular to the two parallel wires M, N is shown in Fig. 1. The field may be calculated by means of conjugate functions in two dimensions. Putting

$$\log(x + iy) = \alpha + i\beta$$

we have the case of a single charged wire, where $\alpha =$ constant is the equation of the equipotential surfaces and $\beta =$ constant is the equation of the lines of force Hence

$$\log\left(\frac{x' + iy'}{x'' + iy''}\right) = \alpha + i\beta$$

gives the case of two oppositely charged wires. Transferring the origin to a point equidistant from the wires and on the line joining them, we find

$$\alpha = \frac{1}{2}\log\frac{b}{a}\quad \beta = \tan^{-1}\left(\frac{-A}{B}\right) = \tan^{-1}\left(\frac{2Ay}{y^2 - A^2}\right)$$

$$R_\alpha = \sqrt{ab},\ R_\beta = \sqrt{A^2 + B^2}.$$

α represents the equipotential lines, and β the lines of force; a and b are the distances from the points M and N respectively to the points $c_1, c_2, c_3 \ldots$ along the axis of X. For given values of a and b, α is constant and so also is R_α, the radius of the equipotential lines, which are therefore circles with $c_1, c_2, c_3 \ldots$ as centres. A is the constant distance ON. B is the distance from O to the points $S_1, S_2, S_3 \ldots$ For a given value of B, β is constant and also R_β, the radius of the corresponding line of force, which is therefore a circle. These two systems of circles divide up the plane into areas which are in the limit squares, and the figure shows how the force varies from point to point. To get the force at any point along the axis of X, find the corresponding value of $\frac{d\alpha}{dx}$, y being zero; and for the force at points along the axis of Y (the force of course being perpendicular to the axis of Y), since $\frac{d\alpha}{dx} = \frac{d\beta}{dy}$, find the corresponding values of $\frac{d\beta}{dy}$, x being zero. Thus—

$$\frac{d\alpha}{dx} = \frac{d\alpha}{db}\cdot\frac{db}{dx} = \frac{A}{2}\left[\frac{1}{R_a^2} - \frac{4A^2}{(A^2 - x^2)^2}\right]$$

$$\frac{d\beta}{dy} = -\frac{2A}{y^2 + A^2}.$$

At the origin $x = y = 0$, and $R_\alpha = \infty$; hence

$$force = \frac{d\alpha}{dx} = -\frac{2}{A} = \frac{d\beta}{dy}.$$

The force increases as we pass either way from the origin along the axis of X, and decreases along the axis of Y. We

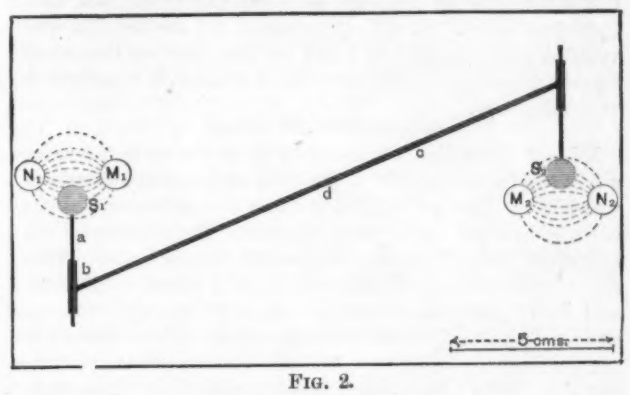


FIG. 2.

may replace any equipotential surface, as α_3, by a conductor bearing a charge equal to that of the line N, and then removing N from the system the space within α_3 is at a uniform potential, and the field without is entirely unaltered. Hence, instead of using two charged lines M N to produce the electric field, two circular cylinders of considerable diameter are employed. A solid dielectric at any point on the axis of Y will approach or recede from the origin O according as its specific inductive capacity is greater or less than that of the medium surrounding it. When the liquid medium is slightly conducting the case is not so simple; for then surface charges develop on the solid, and the lines of force, which are now stream lines, go around the solid. The distribution of energy is modified, and we cannot say at once that the ratio of the specific inductive capacities is the sole criterion which determines the direction of the resultant force on the solid.

THE APPARATUS.

In the experiment there were employed two pairs of electrodes, M_1, N_1 and M_2, N_2, shown in section in Fig. 2. They were of platinum, 0.9 centimetre in diameter, 5.0 centimetres long, and their centres were 2.6 centimetres apart. M_1 and M^2 were joined to one pole of a battery furnishing any desired potential up to 140 volts; N_1 and N_2 were joined to the other pole; and a rotating commutator served to give alternations of 50 to 100 per second. Two cylinders, S_1, S_2, of glass, mounted on glass stems, were carried on the arms of a torsion balance, d being the axis of rotation. The deflection was measured by a telescope and scale, and the force determined in absolute measure. The cylinders of glass were subsequently replaced by cylinders of paraffine, beeswax and other dielectrics, and carbon and brass among conductors. The force f on the cylinders is perpendicular to the direction of the lines of electric force, and is proportional to $\frac{d(H^2)}{dy}$, where H is the electric force.

$$H = C\frac{2A}{A^2 + y^2},$$

where C depends on the difference of potential between the electrodes; f has a maximum value at a point P where

$$y = \frac{A}{\sqrt{5}};$$

that is, about a quarter of the distance between the axes of the cylinders from the origin. About this maximum point the force varies but little for a considerable distance. This is, then, a particularly favorable place to put the solid S, as an exact knowledge of its position is not necessary. A fairly accurate adjustment was, however, always made, by first bringing the solid just between the electrodes where the resultant force is zero, and then turning the torsion head, by means of a lever reaching to the telescope, always

*Communicated by the author for simultaneous publication in THE ELECTRICICAL WORLD and the *Philosophical Magazine* of London.

through the same angle. The resultant force f on the solid is inversely proportional to A^3, and directly proportional to the volume of the cylinder, that is, to the cube of its linear dimensions. *Thus changing the linear dimensions of the system does not alter the force on the solid.* The following is a brief statement of the results observed :

1. Glass cylinders in air, petroleum oils, bisulphide of carbon, turpentine and benzine are attracted ; that is, move into the stronger parts of the field.

2. The force is least in air and greatest in turpentine ; in short, is greater in those media having a greater specific inductive capacity, all, however, being considerably less than that of glass. This indicates that the principal change of energy is in the fluid medium.

3. In water, alcohol and ether (the latter containing water and alcohol as impurities) glass is repelled, the forces of repulsion being nearly in the ratios of 9 : 3 : 1 respectively. In bisulphide of carbon containing about 20 per cent. of the same ether, glass is attracted, but with about 40 per cent. it is repelled.

4. The force of repulsion on glass in water is over 60 times as great as the attraction in air. Since this is approximately the value of the specific inductive capacity of water it suggests, as in the case of glass in liquids of low specific inductive capacities, that the chief change in energy due to the presence of the glass is in the fluid media.

5. The force on the glass is proportional to the square of the difference of potential between the electrodes, and therefore to H^2. In the case of water and alcohol this was verified quite accurately ; and in the case of the other liquids, where the forces were much smaller, it was verified ppr oximately.

CONDUCTING CYLINDERS.

III.—If the cylinder is a conductor and is surrounded by a non-conducting medium, the lines of force are drawn toward it, as lines of magnetic force are gathered up by a piece of iron put into a magnetic field. The resultant force is *always one of attraction toward the electrodes.* This follows from the tendency of the lines of force to shorten, and being more numerous on the side toward the origin, the conductor is drawn in that direction. If the surrounding medium is a conductor, the case is not modified providing the solid is a very muca better conductor. Thus, suppose the cylinder is carbon and the medium water. The latter is a fair conductor, yet carbon conducts millions of times better than does distilled water, and the lines of force will be arranged sensibly the same as though water were a non-conductor and carbon a perfect conductor. The resultant force on the cylinder in a given field will evidently be proportional to the specific inductive capacity of the medium of the field. This is a much simpler case than that of a dielectric solid in a liquid, where the conductivity of the liquid and the specific inductive capacity of the solid affect the result. As before, an accurate adjustment of the position of the conducting cylinders is not necessary, and using the same cylinders with the same difference (or known differences) of potential, this would seem to be an excellent method of measuring the specific inductive capacity of liquids. Accordingly, cylinders of carbon (cut out of an arc light carbon) were mounted in the torsion balance and the force of attraction under various conditions measured.

1. The force, as we should expect, is accurately proportional to the square of the difference of potential for air and all liquids, conducting and non-conducting.

2. The force is approximately proportional to the volume of the cylinder. This was found to be roughly true for three pairs of cylinders of nearly equal length, but of very different volumes, *i. e.*, 0.73, 5.7 and 10.0 cubic centimetres respectively. The force increased somewhat faster than the volumes, which would be expected, as the larger cylinders extend further into the stronger parts of the field near the electrodes. For small changes in the volume the force may be taken as proportional to the volume.

3. The following tables give series of measurements made with the second pair of cylinders (volume 5.8 c. c,) in air and turpentine. Other measurements agreed with these almost exactly.

TABLE I.—AIR.

V=Potentials.	Deflections.	Squares of $\frac{V}{100}$.	Quotients of Deflections by $\left(\frac{V}{100}\right)^2$
105.0 volts.	2.02 cm.	1.102	1.83 cm.
107.0 "	2.08 "	1.145	1.82 "
132.5 "	3.15 "	1.755	1.80 "
118.2 "	2.53 "	1.397	1.81 "
Mean for volts.....			1.815 "

TABLE II.—TURPENTINE.

V=Potentials.	Deflections.	Squares of $\frac{V}{100}$.	Quotients.
101.4 volts.	4.48 cm.	1.028	4.36 cm.
"	4.44 "	"	4.32 "
"	4.45 "	"	4.33 "
101.5 volts.	4.48 "	1.030	4.35 "
"	4.47 "	"	4.34 "
101.2 volts.	4.47 "	1.24	4.36 "
Mean for 100 volts			4.34 "

$\frac{4.34}{1.815} = 2.39$ = *specific inductive capacity of Turpentine.*

In the same way other liquids were treated, and the following values of their specific inductive capacities obtained ;

Water at 16.5° C	$K = 70$
Alcohol, about 93 per cent.....	$K = 30.9$
Ether (with water and alcohol impurities).....	$K = 8.4$
Turpentine.....	$K = 2.39$
Petroleum oil, 300° test.....	$K = 2.04$
Petroleum oil, light illuminating.....	$K = 1.97$

The difference between the above value for alcohol and that previously given for absolute alcohol (25.7) is readily accounted for by the water present in this. Pure ether has a much smaller value than that given above.

This method is capable of giving tolerably accurate results, although it cannot be used with heavy oils ; for the force to be measured is small and the volume of the cylinders is considerable; hence the latter move very slowly through a quite viscous liquid. The method given in the paper already referred to is applicable to such liquids, and is perhaps more convenient for all.

MATHEMATICAL THEORY.

IV.—An exact solution of this problem would be difficult to obtain. An approximate solution may be found as follows : Maxwell (vol. i., ch. v.) gives an expression for the mechanical action between two electrical systems in terms of a surface integral taken over one of them. The value of the Y component of the force is

$$B = \int\int (l\, p_{xy} + m\, p_{yy} + n\, p_{zy})\, ds$$

where ds is an element of the closed surface of one system and l, m, n are direction-cosines of the normal to ds. Writing V instead of ψ for the potential, the values of the p's are

$$p_{xy} = \frac{1}{4\pi}\,\frac{dV}{dy}\cdot\frac{dV}{dx}$$

$$p_{yy} = \frac{1}{8\pi}\left\{\left(\frac{dV}{dy}\right)^2 - \left(\frac{dV}{dz}\right)^2 - \left(\frac{dV}{dx}\right)^2\right\}$$

$$p_{zy} = \frac{1}{4\pi}\,\frac{dV}{dy}\cdot\frac{dV}{dx}.$$

In the present case, if the axis of Z be taken parallel to the axis of the cylinder, $\frac{dV}{dz} = 0$, and we have

$$B = \frac{L K''}{8\pi}\rho\int\left\{\cos\theta\left(\frac{dV}{dy}\right)^2 - \cos\theta\left(\frac{dV}{dx}\right)^2 + 2\sin\theta\,\frac{dV}{dy}\cdot\frac{dV}{dx}\right\} d\theta, \qquad \text{(A}$$

since $ds = L\,\rho\,d\theta$, L being the length of the cylinder and

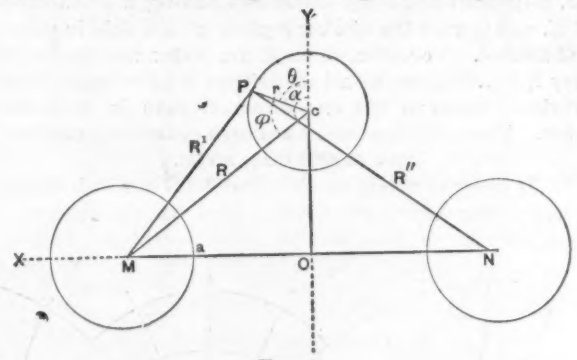


FIG. 3.

ρ its radius. K'' is the specific inductive capacity of the medium, assumed above to be unity. Using r and θ instead of x and y, this expression becomes

$$B = \frac{L K''}{8\pi}\rho\int\left\{\cos\theta\left(\frac{dV^2}{dr}\right) - \frac{\cos\theta}{r^2}\cdot\left(\frac{dV}{d\theta}\right)^2 - 2\frac{\sin\theta}{r}\cdot\frac{dV}{dr}\cdot\frac{dV}{d\theta}\right\} d\theta. \qquad \text{(B)}$$

Since two parallel lines oppositely charged have equipotential surfaces which are circular cylinders more and more eccentric as they become larger (see Fig. 1), we can replace our two parallel circular cylinders by two lines M, N, which are nearer together than the axes of the cylinders The potential at any point P distant R' and R'' from these lines is $V = \log R' - \log R''$.

Expanding $\log R'$ and $\log R''$ in terms of R, r, and the angle φ, we have approximately

$$\log R' = \log R - \left[\cos\varphi\,\frac{r}{R} + \frac{1}{2}\cos 2\varphi\,\frac{r^2}{R^2} + \frac{1}{3}\cos 3\varphi\,\frac{r^3}{R^3} + \ldots\ldots\right]$$

$$\log R'' = \log R - \left[\cos\varphi_1\,\frac{r}{R} + \frac{1}{2}\cos 2\varphi_1\,\frac{r^2}{R^2} + \frac{1}{3}\cos 3\varphi_1\,\frac{r^3}{R^3} + \ldots.\right]$$

$\varphi = \alpha - \theta$ and $\varphi_1 = \alpha + \theta$ hence

$$\log R' - \log R'' = V = -2\left[\sin\alpha\sin\theta\,\frac{r}{R} + \frac{1}{2}\sin 2\alpha\sin 2\theta\,\frac{r^2}{R^2} + \frac{1}{3}\sin 3\alpha\sin 3\theta\,\frac{r^3}{R^3} + \ldots.\right] \qquad \text{(C)}$$

Inside the cyli nder the potential is

$$V' = a_1 r\sin\theta + a_2 r^2\sin 2\theta + a_3 r^3\sin 3\theta + \ldots.$$

Outside the potential is

$$V' = V + \frac{b_1}{r}\sin\theta + \frac{b_2}{r^2}\sin 2\theta + \frac{b_3}{r^3}\sin 3\theta + \ldots.$$

V being the potential when the cylinder is absent, and a_1, a_2, and $a_3 \ldots b_1$, b_2, $b_3 \ldots$ being undetermined coefficients. Substituting the value of V given by equation (C) in the expression for V', we have

$$V' = \left[\frac{b_1}{r} - 3\,\frac{r}{R}\sin\alpha\right]\sin\theta + \left[\frac{b_2}{r^2} - \frac{2r^2}{2R^2}\sin 2\alpha\right]\sin 2\theta + \left[\frac{b_3}{r^3} - \frac{2}{3}\cdot\frac{r^3}{R^3}\sin 3\alpha\right]\sin 3\theta + \ldots.$$

At the surface, where $r = \rho$ the radius of the cylinder, the conditions are that $V = V'$ and $K'\frac{dV'}{dr} = K''\frac{dV''}{dr}$. These equations determine the coefficients a_1, a_2, $a_3 \ldots b_1$, b_2, $b_3 \ldots$ and give

$$V' = 2\left\{\left(K\frac{\rho^2}{r} - r\right)\frac{\sin\alpha}{R}\sin\theta + \frac{1}{2}\left(K\frac{\rho^4}{r^3} - r^2\right)\frac{\sin 2\alpha}{R^2}\sin 2\theta + \frac{1}{3}\left(K\frac{\rho^6}{r^3} - r^3\right)\frac{\sin 3\alpha}{R^3}\sin 3\theta + \ldots\right\}, \qquad \text{(D)}$$

where $K = \frac{K - K''}{K + K''}$. Differentiating this value of V', we have, after putting $r = \rho$,

$$\frac{dV'}{dr} = -2(K+1)\left\{\frac{\sin\alpha}{R}\sin\theta + \rho\,\frac{\sin 2\alpha}{R^2}\sin 2\theta + \rho^2\,\frac{\sin 3\alpha}{R^3}\sin 3\theta + \ldots\right\}$$

$$\frac{1}{\rho}\cdot\frac{dV'}{d\theta} = +2(K-1)\left\{\frac{\sin\alpha}{R}\sin\theta + \rho\,\frac{\sin 2\alpha}{R^2}\sin 2\theta + \rho^2\,\frac{\sin 3\alpha}{R^3}\sin 3\theta + \ldots\right\}$$

To find the value of B (equation B), we integrate with respect to θ between 0 and 2π the three terms under the integral sign.

$$\int_0^{2\pi}\cos\theta\left(\frac{dV'}{dr}\right)^2 d\theta = 4\pi\rho(K+1)^2\left\{\frac{\sin\alpha\sin 2\alpha}{R^3} + \rho^2\,\frac{\sin 2\alpha\sin 3\alpha}{R^5} + \ldots\right\}$$

$$\int_0^{2\pi}\cos\theta\left(\frac{dV'}{d\theta}\,\frac{1}{r}\right)^2 d\theta = 4\pi\rho(K-1)^2\left\{\frac{\sin\alpha\sin 2\alpha}{R^3} + \rho^2\,\frac{\sin 2\alpha\sin 3\alpha}{R^5} + \ldots\right\}$$

$$\int_0^{2\pi}\sin\theta\left(\frac{1}{\rho}\cdot\frac{dV'}{dr}\cdot\frac{dV''}{d\theta}\right)d\theta = 0.$$

Substituting in equation (B) we have, since

$$(K+1)^2 - (K-1)^2 = 4K = 4\,\frac{K' - K''}{K' + K''},$$

$$B = \frac{L\,K''}{8\pi}\cdot\rho\cdot 4\pi\rho\cdot 4\,\frac{K' - K''}{K' + K''}\left\{\frac{\sin\alpha\sin 2\alpha}{R^3} + \rho^2\,\frac{\sin 2\alpha\sin 3\alpha}{R^5} + \ldots\right\} \qquad \text{(E)}$$

But $L\pi\rho^2 = v$, the volume of the cylinder.

$$\sin\alpha = \frac{A}{R}.$$

$$\sin 2\alpha = 2\,\frac{A\,B}{R^2}$$

$$\sin 3\alpha = 3\,\frac{B^2 - A^2}{R^3}\cdot\frac{A}{R}.$$

For the case of a conducting cylinder, as carbon, K' is unknown ; but, owing to its conductivity, the distribution of potential is the same as though K' were infinite. Hence

$$\frac{K' - K''}{K' + K''} = 1.$$

Substituting these values in equation (E), we have,

$$B = \frac{4v}{\pi}\,K''\cdot\frac{A^2\,B}{R^6}\left\{1 + \frac{\rho^2}{R^2}\cdot\frac{3B^2 - A^2}{R^2} + \ldots\right\}$$

In the experiment $A^2 = 5B^2$, $B = 1.22$ cm , and in the case of carbon cylinders, $v = 2.85$ cc., the volume of one cylinder. Substituting these values in the formula, and neglecting the small second term, we have for air,

B = 0.52 dyne.

It does not appear as yet what is the strength of the field, or the difference of potential between the electrodes. Our formula for the potential due to two parallel wires is

$$V = \log R' - \log R'' = \log\frac{R'}{R''};$$

this shows that along the axis of Y where $R' = R''$, $V = 0$. At a (Fig. 3) $R' = 0.37$ cm., and $R'' = 2.07$ cm., whence $V = \pm 1.72$ electrostatic units, or ± 516 volts. The force of 0.52 dyne calculated above is therefore for a difference of potential of 1,032 volts between the electrodes. For 100 volts, since the force is inversely as the square of the difference of potential, it would be $\left(\frac{1,032}{100}\right)^2 = 106.5$ times less; or

B = 0.0049 dyne for 100 volts.

The torsion of the suspending wire was determined, and found to require 0.0040 dyne for each centimetre of deflection on the scale. As 100 volts gave 1.50 centimetres with carbon cylinders in air (for *this position* of the scale), this would correspond to 0.0060 dyne. Thus the measured force is nearly of the same magnitude as the calculated, but about 20 per cent. greater. This is probably due in large part to the effect of the ends of the cylinders, which tend to increase the force, and of which no account was taken in the calculation. Moreover, the electrodes being short, the field would not be quite uniform along the axis of Z as was assumed ; this would be strictly true only for infinitely long electrodes.

The agreement is, however, sufficient to serve as a verification of the formula which, although only an approximation, is yet of a good deal of interest. For the purpose of determining the specific inductive capacities of liquids, we have only to compare the forces on the same cylinders in the several liquids, and the error due to the ends of the cylinders has no effect.

The experiments were carried out last year at the Physical Laboratory of the Johns Hopkins University, and this paper, together with the one already referred to, constituted a thesis offered for the degree of Doctor of Philosophy. I have to thank Prof. Rowland for the solution given in the fourth part of the present paper.

WESLEYAN UNIVERSITY, Middletown, Conn., July, 1892.

The Siemens & Halske Dynamos.

The tendency toward the employment of large units for the generation and distribution of electric light and power has been gradually growing in this country for some time. This has long been the practice in Europe and with very satisfactory results. Silvanus P. Thompson, in his recent work, "Dynamo-Electric Machinery," states that he has been of the opinion for years past that large dynamos are preferable, not because he has any admiration for mere bigness, but because, as in steam engines, the large machines may be made more efficient than the small in proportion to their cost. Gisbert Kapp has made the following estimate:

Diameter armature	10 inches	15 inches.
Revolutions per minute	1,000	670
Number of glow lamps	150	620
Price	$500	$1,380
Electrical efficiency	80 per cent.	89 per cent.

showing four times the electrical output for a little more than twice the cost.

Siemens & Halske, recognizing the fact that large dynamos coupled directly to the steam engine shaft and running at comparatively low rates of speed, thereby saving the expense of belting with its corresponding loss of power through friction, slipping, etc., were certain to be the machines of the future, turned their attention to the designing and construction of such machines and have gone from 500 h. p. to 1,000 h. p., thence to 1,500 h. p. and now to 2,000 h. p., a size about three times as large as built so far in this country.

The accompanying illustration, Fig. 1, shows one of the 1,000-h. p. alternating machines coupled direct to a 1,000-h. p. Collman engine. This machine develops 700 k. w., 2,000 volts and 350 amperes. The armature, which is 15.1 ft. in diameter, is stationary. It has 60 poles, and the field magnet ring consists of 60 bobbins, rotating inside the armature, which has the same number of coils. The outside diameter of the rotating field magnets is 12.2 ft. The number of revolutions is 100 per minute, so that there are 6,000 changes per minute in the poles.

The field magnets are excited by a direct current, which is brought from an exciter machine, every coil insulated with hard rubber from all metallic connections, and the stationary armature, such as is used in this type of machine, enables the maker to provide much better insulation than when the armature itself revolves.

The other illustration, Fig. 2, shows the direct current dynamo. It is of the inside pole ring type, which class has from four to twelve poles. They are placed in the form of a star inside the rotating armature. The brushes, which are always of the same number as the field magnets, take off the current from the outside of the armature winding.

The armature itself consists of an iron core wound with copper segments. The special machine herewith illustrated has ten poles, and is designed for an output of 746,000 watts. This machine can be built without special commutator from 100 to 700 volts, and can be used for lighting and power. The loss of voltage in the armature is only 2% with maximum load. For exciting the field magnets, only 1½% is required. Therefore the electrical efficiency of this machine is about 96½%. It is shunt wound and has a surface velocity of 50 ft. per second.

FIG. 1.—SIEMENS & HALSKE ALTERNATING CURRENT DIRECT COUPLED GENERATOR.

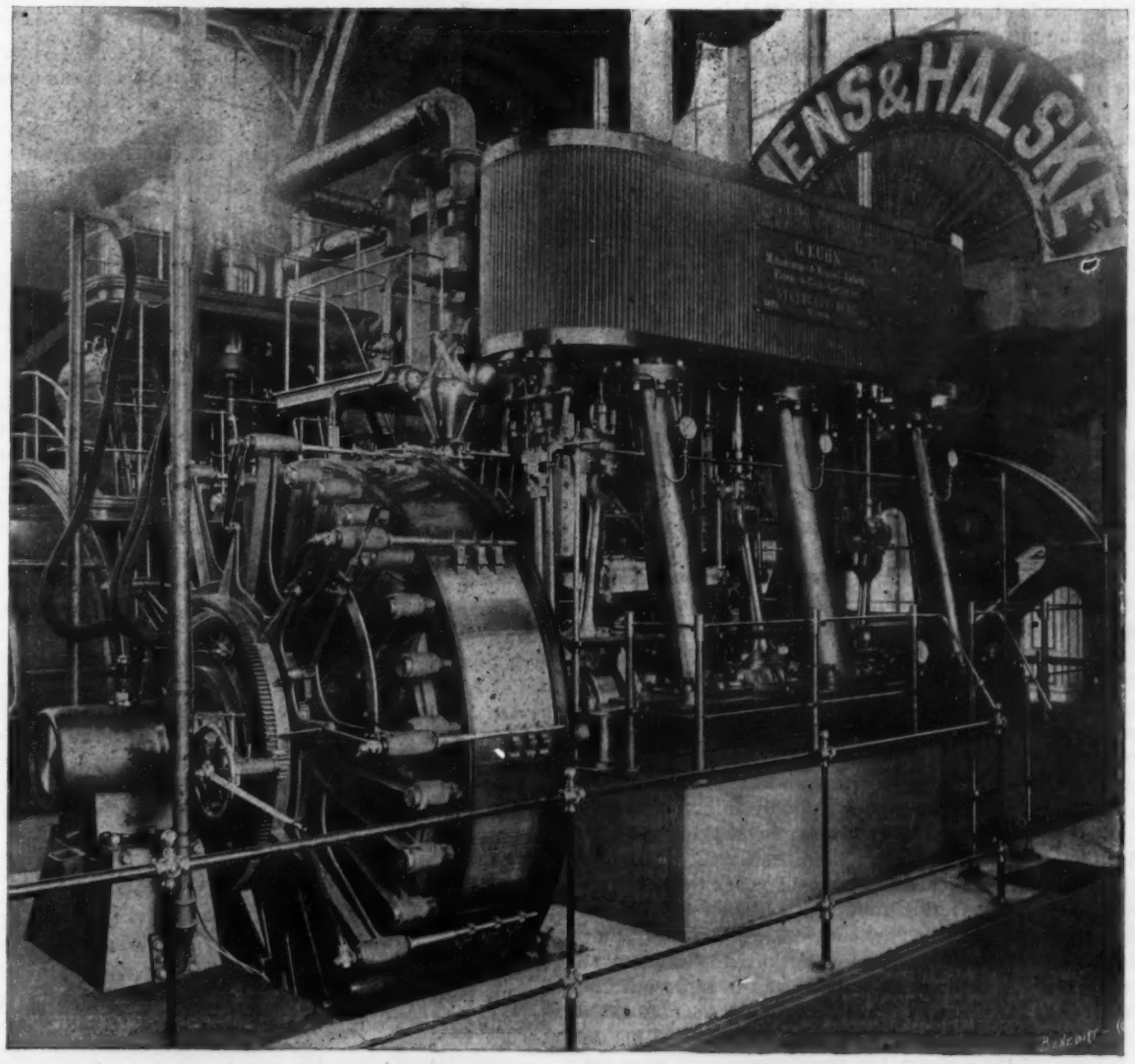


FIG. 2.—SIEMENS & HALSKE CONTINUOUS CURRENT DIRECT COUPLED GENERATOR.

The works of the Siemens & Halske Electric Company of America are located in Chicago. They receive all drawings from Berlin, and will duplicate the construction that has been the result of the vast experience gained by Siemens & Halske during the half century of their existence.

A Short History of Electro-Therapeutics in America

Medical electricity was for so many years identified with and used as a synonym for quackery that it is rather hard to separate the dross from the pure metal. Dr. Thomas Brown, of Albany, was the first to advocate the use of electricity as a curative agent in a purely scientific way. In 1823 he published a small volume entitled "The Ethereal Physician," in which he advised the use of Franklinic electricity for epilepsy, paralysis, chorea, etc. This was the first positive effort, and, although about this time a Dr. Everett, of New York, took hold of the subject and contributed more or less to the medical publications, it was a number of years before it obtained anything like a tithe of the foothold it has since secured. This, it must be confessed, is due to a laudable, but in this case rather overstrained, conservatism on the part of the physicians themselves. Dr. Rockwell, one of the older electro-therapeutists in the country, relates many anecdotes of the opposition he encountered when he first took it up as a definite branch of his practice. Looking back over this period of the science we do not find many instances of advancement. Induction electricity had not yet made itself known. The applications of the old cylinder static machine, or, still further, the voltaic pile, were unsatisfactory in their action, and altogether viewed as a medical science it was not only neglected, but fell into absolute disrepute. Faraday in 1831 by his discovery of induction electricity gave an impetus to it which was followed by a worse than damaging reaction. The new cure-all, as it was confidently expected to be, was lauded to an extent which could have but one result, and when it failed to cure not only all, but even a respectable percentage of all, the ills to which flesh is heir, it boded ill for its immediate advancement as a definite medical science, and moreover fell into the hands of conscienceless laymen who brought with them a name with which most physicians hardly cared to connect themselves. Still it was a recognized fact that these so-called quacks did sometimes effect positive cures in cases which had failed to be effected by the ordinary form of relief. Dr. Rockwell records the fact of his meeting at the bedside of a patient an old man, who had for years been known to the physicians of New York. Without possessing the slightest knowledge of anatomy, or physiology, or of any of the principles and practice of medicine, this man had for thirty-five years followed the business of administering electricity, and in that time had treated an enormous number of cases. The percentage of cures was so large as to excite no inconsiderable amount of comment. This was fact; but it was not science. These charlatans knew that certain modes of applications were liable to produce desirable results, but the why or the wherefore was quite another matter and foreign either to their thought or inclinations. They were in "business" in the strictest sense of the word, and in business to make money at that; the feeling, the desire, or the instinct of the scientist was farthest from their nature, and as a consequence electro-therapeutics was none the better off for their sponsorship. Then it was

that a few courageous spirits dared the possible calumny that might attach, and did attach itself to their names, and began the systematic study and research which was the real beginning of electro-medical science as it is known to-day. Names which have since become more or less famous were signed to the articles which began to comprise the literature of the subject. Duchene, Remak, Benedikt, Schultz, Meyer, Neumann, Rosenthal, Frommhold, Eulenberg, and others contributed to the medical journals, and the line of the specialist was soon mapped out. In the field of localized electrization the above-named men were especially active. Here, however, in the infancy of the science, we find glaring errors, the result of insufficient knowledge of special branches and of the physical effects. The partisan of the galvanic current held heated controversy with the partisan of the faradic, and the result for a while was a general chaos of unsystematized fact. The claims of Beard and Rockwell to having, in the earlier days, reduced this chaos to something like scientific order are pretty well substantiated. Supplemented as they were by Prof. Erb, of Heidelberg, they will bear special mention. After asserting and demonstrating that electrization "was something more than a mere stimulant, and as such was indicated in a wide range of diseases associated with general debility and impaired nutrition" they claim "to have improved it, reduced it to a system and given it a scientific basis, and to have shown its relation to other methods of using electricity; in short, to have done for the method of general faradization what Duchene did for localized faradization; to have interpreted its special and general effects; to have given it a name, pointing out the true rationale of the method, and the indications for its use; to have first called the attention of the profession to this method, enforcing these views by the results of experiments, and awakening an immediate interest in this department of therapeutics."

During the latter portion of the present era of electro-therapeutics the science has been naturally apportioned into special departments which have had able coadjutors. Following in the line of Apostoli, of Paris, whose researches in gynecology have given him an international reputation, we have in this country Drs. Engelmann, Massey, Martin, Munde, Grandin, Gunning, Goelet, Bigelow, Kellogg and Hutchinson, who are among the principal ones in this field. Dr. Wm. J. Morton's discoveries in Franklinism, or more properly in static electricity, have enlarged this field. What is known as the static induction current is a distinctly American discovery which widens the ordinary scope of the Holtz machine. Dr. Newman in the line of stricture reduction by electrolysis has accomplished wonderful results.

Much of this advancement has only been made possible by the ever increasing excellence of the various kinds of electro-medical apparatus. While this in large part is due to the physicians themselves it owes its degree of advanced perfection to the various dealers who, catering to the needs of the therapeutist, have made a special study of the mechanical part of the science.

The scope of electricity in medicine is an admittedly large one. The days of quackery and charlatanry it is to be hoped are past. It was not to be expected that, regarded as a cure-all, it could meet all the requirements that were demanded of it, and now that it has been reduced to a scientific basis, we may confidently expect it to take its place as one of the great medicines of the pharmacopoeia.

The American Electro-Therapeutic Association: Its History and Purposes.

In reviewing those institutions of a more or less prominent character, whose reputation is of anything like a lasting nature, it is a noticeable fact, almost without exception, that they have had their beginning in a very small and humble manner. It is also noticeable that their development has been a thing of slow but steady growth. "Time is a respecter only of that for which she herself is responsible," says a prominent writer, and an examination into the careers of some institutions of the kind mentioned would seem to bear out the truth of the statement. Following in the line of its historical predecessors, the American Electro-Therapeutic Association is no exception to the rule. Beginning in the humblest and most unassuming manner it has risen almost from what was a mere meeting for social or friendly intercourse into one of the strongest and most important of medical institutions.

It was not until comparatively recent years that electro-therapeutics assumed the important position before the profession at large that it now occupies. A desultory fact recorded here and there, a contribution to a medical journal now and again was all there was to represent the literature of what is now a well grounded science. The whole business was looked upon as a thing quite outside the domain of the respectable practitioner, and was not encouraged in the least. Hence it was that its advocates labored under disadvantages and drawbacks to which they themselves indirectly contributed. As single members of a vast body of men with set codes of ethics it was discouraging, to say the least, to take up with a line of thought and practice which all but transgressed one of the then established rules. It was decided, however, to effect an organization for the purpose of carrying out those ideas which were the natural result of observation and practice. Previous to this time it had been the habit of several members of the New York coterie of practitioners to meet at stated periods, and by the comparison of notes, experience, statistics, etc., to record as much information on the co-operative plan as possible. Finally the taking in of new members and the accumulation of new ideas began to manifest their importance in such a very decided manner that it was determined to form a regularly incorporated body for the purpose of accumulating, recording, and disseminating all knowledge in any way relating to the application of electricity in medicine and surgery. A call issued to the leading electro-therapeutists of the country resulted in quite a gathering, and on Thursday, Jan. 2, 1891, the society was formally organized. The organization's meeting was held in the New York Academy of Medicine, with the following charter members:

Wm. J. Morton, M. D.; A. D. Rockwell, M. D.; Ephraim Cutter, M. D.; Robert Newman, M. D.; F. von Raitz, M. D.; A. H. Goelet, M. D.; Margaret A. Cleaves, M. D.; Anna M. Galbraith, M. D., of New York. E. M. Mosher, M. D.; A. L. Sherman, M. D., Brooklyn. Horatio R. Bigelow, M. D.; G. Betton Massey, M. D.; Wm. H. Walling, M. D., Philadelphia; Geo. H. Rohé, Baltimore.

Dr. Massey acted as chairman of the first meeting and was elected president. The first vice-president was Dr. W. J. Morton. The second vice was Dr. A. H. Goelet. Dr. Walling was secretary, and Dr. Rohe was treasurer. A constitution was formally adopted, and it was decided to hold the next meeting, which was to be the first annual one, at Philadelphia on the following Sept. 24, 25 and 26.

Thus was organized the American Electro-Therapeutical Association, which has since had a very rapid growth. Immediately upon its organization applications for membership poured in from all sides, until at the meeting in Philadelphia it was more than three times what it had been at the organization. Since then, of course, it has still further increased.

The Electro-Therapeutic Association has become an established fact, one not likely to vanish into the thin air of defunct society recollections. The list of active members is composed of the names of the foremost electro-medical men in the United States. The honorary list comprises the names of the foremost men of the world. It is as follows:

Dr. Inglis Parsons, London; Dr. Skene Keith, London; Dr. Henry McClure, Cromer, Eng.; Dr. Massin, St. Petersburg; Dr. Soutakis, Constantinople; Dr. Benedikt, Vienna; Dr. Temesvary, Budapest; Dr. La Torre, Rome; Dr. Apostoli, Paris; Dr. Oninus, Paris. Dr. Larat, Paris; Dr Gautier, Paris; Dr. Tripier, Paris; Dr. DuBois Reymond, Berlin; Dr. S. Weir Mitchell, Philadelphia.

The officers for 1892 are as follows:

President, Dr. Wm. J. Morton, New York.
Vice-Presidents, Dr. A. H. Goelet, New York; Dr. Wm. F. Hutchinson, Providence.
Treasurer, Dr. R. J. Nunn, Savannah.
Secretary, Dr. Horatio R. Bigelow, Philadelphia.
Executive Council, Dr. G Betton Massey, Dr. Robert Newman, Dr. A. D. Rockwell, Dr. W. H. Walling, Dr. H E. Hayd
Committee of Arrangements, Drs. Morton, Goelet and Newman,
Committee on Standard Coil, Drs. Morton, Goelet, Massey and Hutchinson.
Committee on Standard Meters, Drs. Adams, Hayd and Robinson;

The last meeting of the society was a notable one in many respects. Each of the papers read was, as a rule, an able discussion of the subject under treatment, and if published in pamphlet form would make excellent reading for special distribution. "Electro-Therapeutics in America," by Dr. A. D. Rockwell, was an intelligent resume of what had been done in this field in the earlier days. Dr. Augustin H. Goelet read a paper on "The Action and Application of the Faradic Current in Gynecology," in which he maintained that improperly constructed apparatus is the cause of the indifferent results that have been obtained by various observers. He discoursed at length on the technical construction of faradic apparatus, and gave the evidence of his observation and experience, the printed account of which could be made of considerable value to the makers of this class of goods. "Electricity in Carcinoma," by Prof. Newman, as well as a "report of 75 cases of myomata treated with electricity," by Dr. J. H. Kellogg, were subjects of a strictly medical nature, and had nothing to do with the physics of the science. Dr. Wm. James Morton read one of the most interesting papers of the session, entitled "A Suggested Basis for Electro-Therapeutical Administration, Founded Upon Metabolism, or Chemical Exchanges in Living Tissue, and Involving Accurate Differentiation in Poles." "Electricity in the Treatment of Rheumatism," by Dr. W. F. Robinson, was another of a popular character. "Has Electricity Any Action as a Germicide" was read by Dr. Blackwood. "Electrical Contact Force" was the subject of a paper which was read by title for Dr. Henry McClure, of Cromer, Eng.

Notes on Electro-Therapeutics.

The idea of electric light current as a means of medical treatment has reached Russia. G. J. Gachkovski, in a Russian medical journal of recent date, dwells at some length on "electrical light as a means of treatment in electrotherapy."

The bogus "electric" belt industry is at last receiving proper attention in the hands of the medical profession in England. A. Geo. Bateman, M. D., Hon. Sec. of the Medical Defence Union, asks the readers of the London "Lancet" to forward him as much information as possible regarding the concerns with which they may have had dealings.

We are informed through the columns of the "Medico-Legal Journal" that a movement has originated in the French senate regarding the introduction of electrical execution in France. The final success of the more recent New York trials is the direct cause of this, and a prominent member of the French body has recently been advocating the question in a manner which may result in its adoption. The time honored guillotine will then be relegated to a place among other back-numbered historical relics, and the name of its illustrious god-parent may escape some of the opprobrium which we hear from time to time heaped upon it. Dr. Guillotin was not the inventor of this bloody relic, however much he may have improved it, and it is a lasting injustice to the medical profession that the name of one of their number should be coupled with, much less actually applied to, such a degrading invention.

The Electro-Therapeutic Convention, which is being held this week at the New York Academy of Medicine, more than ever illustrates the desirability of establishing an electrical professorship in our medical colleges. The present ordinary medical college curriculum does not, we believe, include much instruction in this line, and the graduate, outside of a few desultory lectures which may happen to creep in during the course, is totally unprepared to cope with those diseases which succumb only to the electric current; or, if it so happens that he, foreseeing this fact, should "read up" on the subject during those moments not occupied by his regular study, even then he lacks that facility which actual work and practice alone can give, and the result is often a deplorable exhibition of half-acquired knowledge, which is apt to assume a ludicrous phase not at all conducive to professional standing or to financial prosperity. All this would be obviated were an electrical professorship an established thing. To be sure, the various post-graduate medical schools all contribute their quota to the several lines of medical electrics; but a post-graduate course is an expensive luxury in which every graduate cannot indulge. The coming together of so many physicians and others interested in electro-therapeutics this week should witness something done in this important matter, and before they disband it is to be hoped that some of its advocates, if it has any, may take some action which will result successfully in establishing such professorships.

Dr. S. V. Clevenger, of Chicago, writing to the "Times and Register" of recent date has this to say of dry cells:

"Noticing that the merits of the dry cell were under discussion in your journal, I beg leave to state that when the Barrett Bros., of New York, first invented their sealed cells I secured several of their batteries. That was eight years ago, and I have a fifty-cell galvanic of their make, the voltage of which has been but very little reduced after being in occasional use for electro-diagnosis during all that time, at least twice weekly for a quarter of an hour, and for the last six months my son has used it daily in electrical engineering tests of resistance in telephone work.

"A faradic of four cells and another galvanic of fifty cells, made by the Baltimore company in which Barrett is a consulting electrical engineer, I have had in almost daily use, averaging ten minutes per day, for two years past and not one of these batteries has needed refilling, or has given the least trouble to me in getting ready for use; or so far as current strength is concerned, beyond an occasional looking after connections and taking care that some uninformed person did not destroy the cells by interfering with them; and in this necessity for care and knowing what one is about, lies the secret of getting effective work out of any instrument. Long before the days of the dry cell there was an incessant complaint by men who knew little of electrical appliances, that the acid batteries were nuisances and always getting out of order, when it was the want of knowledge that made them useless.

"A friend of mine had a dry cell chloride of silver contemptuously stuck away in a closet as worthless, and a peppery correspondence had been kept up between him and the manufacturer. Upon the merest inspection of two seconds, I discovered that a little lacquer had run over one of the brass strips so as to insulate the connections from one another, and in two seconds more a pen-knife scraping set the faradic to buzzing with a current strength my friend could not endure.

"At another time I witnessed a salesman in an instrument store gravely instructing a purchaser how to make connections with one wire in a primary, and another in a secondary connection, and both concluded the machine was of no account. The most trouble comes from short circuiting by leaving some means of connection between the nipples in the box, either water or the cord terminals, or sometimes a metal instrument. An office partner of mine 'cooked' my last fifty cell battery all night on a hot steam coil, but it is still working, though I wonder at its doing so.

"If only half the people know how to use a watch properly, it isn't to be wondered at that so delicate, but effective, an apparatus as a chloride of silver cell needs at least intelligent care. For that matter, many people abuse their stomachs and growl at the resulting indigestion.

"If physicians will seek the opinions of electrical engineers as to the merits of batteries, they will find that they do not only approve of the chloride cells, but use

them constantly in their tests, and laugh at the bungling of parties who would denounce any kind of an electrical instrument as an excuse for clumsiness and ignorance of the principles involved."

Dr. Geo. E. Fell, in a paper read before the "American Medical Association," at Detroit, recently revived the question of electrical execution, choosing for his subject "Electrodes and Their Application to Electrocution." After speaking at some length on the various methods that had been used, Dr. Fell said:

"A still more desirable location, however, both theoretically and from a physiological standpoint, and also from the standpoint of results in experiments on the lower animals (in which it has been demonstrated that the nearer the electrode is placed to the heart the more suddenly its action is made to cease), would be the application to the abdomen in the epigastric region. The size of the electrode (within reasonable bounds it should be, of course, quite large, say 16 to 24 square inches of surface) would probably have very little effect on the result. The object, however, it seems to me, is that the full intensity of the current be applied to the cardiac region, the force then expended directly upon the heart before great dissemination of the current is produced by the great cross section of the body in this region. By none of the means heretofore used would it be possible so markedly to influence the heart by the passage of the electric currents. The abdominal application also could more readily be accomplished. The electrode could be applied before the culprit left the cell by a strap around the body, the electric connection being made after he was placed in the chair and the saturating of the electrodes carried out by the same irrigating measures (fountain syringe) used at Auburn at the Tice electrocution."

In the proceedings of the Jefferson County (Ky.) Medical Society, recorded by the "Medical and Surgical Reporter," Dr. I. N. Bloom, of Louisville, is credited with several suggestions regarding the technique of hair removal by electrolysis, which may be turned to good account by electro-medical instrument makers who aim to produce the correct thing. Says Dr. Bloom:

"With a suitable light, which must be the very best, the patient must be seated in an easy chair with head rest, the battery properly prepared, and the negative pole grasped by the patient after the needle connected with the positive pole has been inserted in the hair follicle. After a short interval the circuit is broken by releasing the negative pole, the needle is removed and the life of the hair is destroyed.

"The kind and number of cells of a galvanic battery is immaterial, provided a current sufficiently strong, i. e., up to three milliamperes, can be obtained. Different operators prefer different batteries. I have used two kinds and note no difference in the effect. In order to do good work, a galvanometer is not only very important, but is absolutely essential. With it and a rheostat all the other trivialities can be disregarded. In the circuit I place the rheostat and galvanometer, the latter measuring in milliamperes. I use all the cells in order that one shall not be used up more than another, and regulate the intensity through the galvanometer by means of the rheostat. In general I aim to use the least number of milliamperes, which in ten or twenty seconds I have found by experience suffices to permanently destroy the hair. This I find varies on different parts of the body, and not always with the coarseness of the hair.

"I never like to operate with a stiff needle. I use a 'platino-iridium' needle, although I imagine my flexible metallic needle might do as well. It is often necessary to bend the needle in order to get at hairs which would be inacessible to one perfectly straight; as for instance, such as are situated low down on the neck. A steel brooch is much more difficult to handle. The point should not be too sharp, as the catherization of the follicle is rendered more difficult thereby.

"No battery is reliable without a galvanometer. The resistance to the currents offered by different patients varies, as, indeed, it does in different places in the same patient. The batteries, too, vary, not only from day to day in strength of current, but from hour to hour. One patient grasps the electrode more strongly than another, etc. It takes but a few minutes to regulate the resistance by means of the rheostat, and once having registered the desired number of milliamperes, there is but little necessity for changing the rheostat, in any sitting, to maintain the required number."

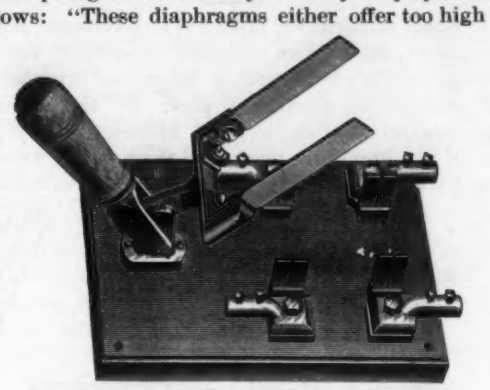
The Victor Lightning Break Switch.

The latest thing in the line of station switches is the Victor lightning break switch made by the Consolidated Electric Manufacturing Company, 335 Congress street, Boston, Mass., which they claim will break 1,000 volts without arcing. The novel feature is the arrangement of the handle, which is set out from the switch at right angles and contains within itself a roller bearing spring, which throws the circuit completely on or off, by a very small movement of the handle. The superiority of the movement can be best understood by station men, and especially those using double throw or dynamo changing switches, for the circuit is closed immediately on one line, and at the same instant opened on the other.

Electro-Metallurgy.—XVI.

BY F. M. F. CAZIN.

Messrs. Siemens & Halske, in applying (Jan. 3, 1889) for a new patent, state in relation to their experience with horizontal diaphragms such as they formerly employed (Fig. 3) as follows: "These diaphragms either offer too high electrical resistance, when made to resist mechanical strain, or if made to not offer excessive resistance to current, they cannot carry the load they are intended to and in consequence sag and break."



The Victor Lightning Break Switch.

They then propose an arrangement shown in Fig. 1, a, b and c, of which they are at present erecting the first on this continent, at Milwaukee, Wis., in an establishment, that will serve as a practical demonstration of their achievements in this line.

The distinctive features of this arrangement as against the older form of passive cells used by the same firm and shown in Fig. 2 are: (*a*) the canvas diaphragm, spanned

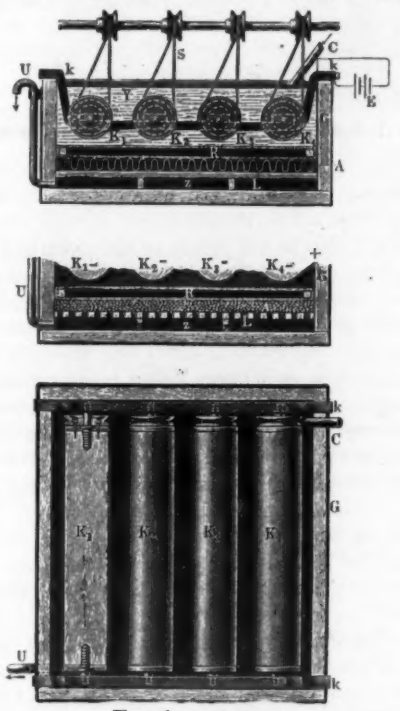


Fig. 1, A, B and C.

at some elevation over the carbon anode in their former arrangement, is substituted by a felt or filter cloth (*R*) resting immediately on the anode (*A*), such anode *A* being made of corrugated and perforated sheet lead and of a layer of broken carbon, both resting on a false perforated bottom (*L*). (*b*) In lieu of stable cathodes there are revolving cathodes in the shape of wooden cylinders (*K* 1-4) covered with sheet copper, the same as their stable horizontal cathodes were theretofore.

The cathiolyte (cupric sulphate and ferrous sulphate) is deprived of the greater portion of its copper contents in the upper space of the vat, and after penetrating the filter

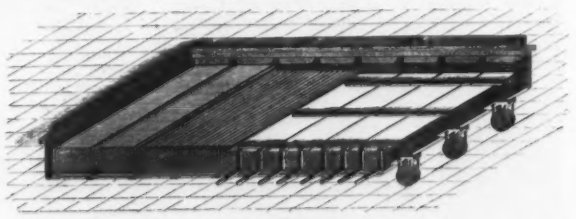


Fig. 2.

sheet (*R*) and when in contact with the anode is converted into an aniolyte that contains ferric sulphate besides the remainder of cupric sulphate.

For carrying out this scheme Messrs. S. & H. manufacture apparatus, the general arrangement of which they show by Fig. 3 as follows:

A. Solution vat (cupric sulphate and ferrous sulphate). *B*. Feed pipe (cupric sulphate and ferrous sulphate). *C*. Bath (electrolytic decomposition cell); *k*, cathode chamber; *b*, anode chamber. *D*. Discharge pipe (ferric sulphate). *E*. Ball mill. *F*. Ore launder to leaching vat. *G*. Conduit to leaching vat (ferric sulphate). *H*. Leaching vat (ferric sulphate and ore). *I*. Discharge from leaching vat (ore, cupric sulphate and ferrous sulphate). *K*. Filter. *M*. Filtrate conduit (cupric sulphate and ferrous sulphate).

As the consideration of apparatus has thus involved the necessity of further describing one of the chemical schemes set into operation thereby, it is but just to now compare it with such competing schemes as claim our attention, and to discuss their comparative merits.

Copper sulphides possess in themselves, besides warm water, all that is needed for wet extraction. And the old Augustin & Ziervogel process for performing this extraction through the instrumentality of first calcining for sulphates and of subsequent extraction with warm water is so simple and reliable, when followed by an adequately arranged electrolytic precipitation of the copper, under the use of soluble anodes, that there seems no good cause to exist for substituting this method by any other. When the equivalent values belonging to the treatment of mixed copper and iron sulphides, such as invariably are the subject of treatment, are properly calculated, it will be found that

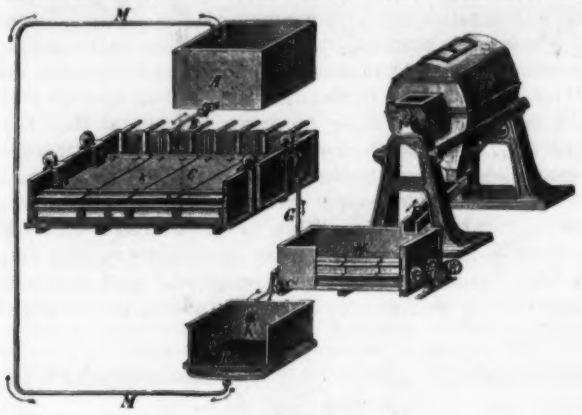


Fig. 3.

there is an excess in all cases of sulphur in the ore as against what is required to form sulphates for the purpose of solution and extrac ion. As a consequence different portions of the ore require different treatment. And a portion of the sulphur remains available for the production of commercial sulphuric acid, when such acid can be utilized or disposed of at a profit.

Although this is no place for discussing general metallurgical problems, no full understanding of the subject of electrolytic copper production can be attained without becoming familiar with at least one of the many technical schedules for such production. Fig. 3 shows Marchese's original schedule, with such modifications as by experience are induced. The economical necessity of simultaneous production of other valuable articles is self-evident.

The Hartmann scheme applies itself still closer and more effectively to the natural condition of the case, where both the copper sulphate and SO_2 may be produced by calcining different portions of the ore for the two different purposes, and the entire success of the proceeding only depends on the appropriate conducting of the operation of calcining. Under older methods this depended much on skilled labor employed at the reverbatory calcining furnaces, a class of labor not easily to be obtained on this continent. American ingenuity and perseverance has overcome this difficulty. For years there has been operated at the now defunct New York Metallurgical Works a calciner called the Walker-Carter, which answered the requirements of the case to perfection and with never failing success, when inteligently

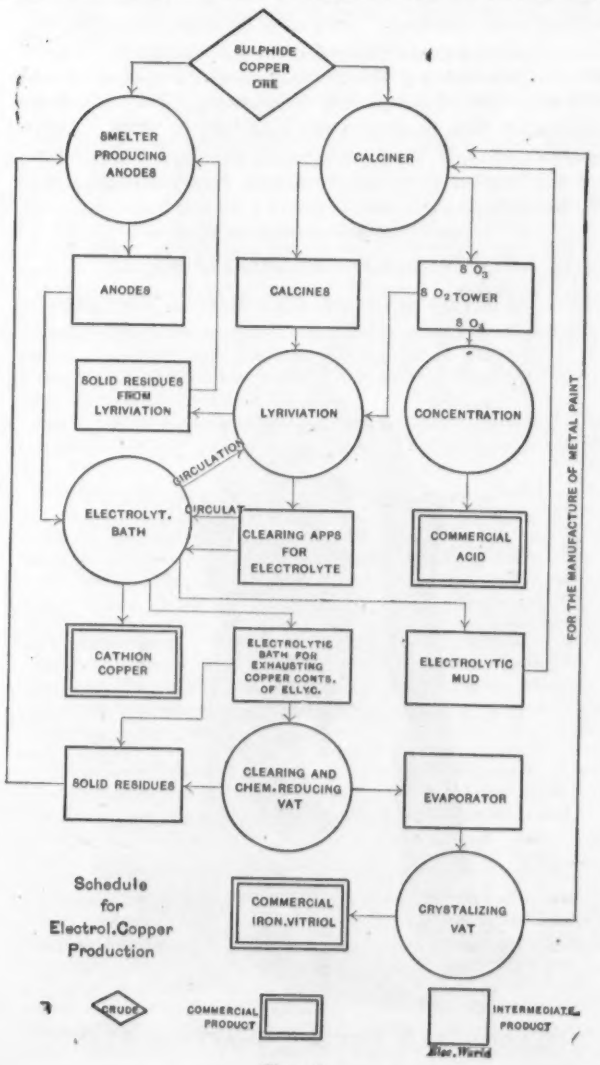


Fig. 4.

conducted. It is a mechanical calciner that does, when once properly set, the required work (feeding, calcining and discharging automatically) properly in calcining the crude ores and also eventually the iron vitriol for manufacturing metal paints therefrom, and does so at less cost and with better perfection than any other apparatus known to me.

If it be considered that by the Hartmann method and under use of a calciner, that does the work well under an intelligent conductor, the further possibility is offered of

turning to profit all that the ores contain: copper, sulphur and iron, the latter by electrolytically exhausting the electrolyte of copper and by crystallizing therefrom the iron vitriol or reducing what copperas cannot profitably be disposed of to colcothar (Bohemian or French red), it does not appear doubtful, that by these simplest, often singly tried, means the best and most profitable results can be obtained, such as under other methods are not obtainable.

If it has been stated that in more successful precedents and in utilization of all components of the ore the scheme, in which use is made of the Hartmann electrolytic part of action, is preferable to the Siemens & Halske scheme, not all has been said in Hartmann's favor that may be said. The main virtue of those processes in general that deal with SO_4, as the medium of copper solution and extraction, consists besides those quoted above in their general applicability to sulphide copper ores, as they most frequently are produced in mining. While the Siemens ferro-sulphate and ferri-sulphate process can be successfully applied only to high grade copper ores, the sulphuric acid processes apply equally well to ores containing a large proportion of iron.

The Cardarelli Electric Light Crane Company's Improved Mast Arm.

One of the most important features of an arc street lighting system is the mast arm. The forms which have been employed in the past have not only caused much inconvenience but have consumed a great deal of valuable time, for it is a matter of considerable work for the trimmer to lower the lamp, replace the carbon and adjust it again. The mast arm which is shown in the accompanying illustrations is so designed that the lamp can be lowered to the base of the pole and trimmed without the attendant moving away from the pole. It consists of two iron clamps for bolting to the pole with sockets for holding a one-inch pipe, which is riveted thereto. Two right angled triangles are thus formed that can be placed at any desired height on the pole. Between the triangles is hung the balanced arm, suspended in the middle by a pivot which is supported by the outer end of the truss formed by the two triangles.

This crane or arm is made of two pieces of one-inch pipe of the desired length of arm, with a casting in the middle by which it is pivoted, and also a casting on the outer end to which the pulley is attached. The angle end is provided with adjustable weights to offset the weight of the lamp. The crane when down places the lamp within easy reach of the trimmer, as may be seen by reference to Fig. 1. This is done by the drop-light attachment, which consists simply of a pulley attached to the outer end of the balance arm through which a cable, rope or chain is passed and fastened to the lamp, the other end of the rope being attached to such a part of the truss below the pulley as to stop the lamp, which follows the outer end of the arm as it is lowered.

The cranes are manufactured of one-inch pipe, and are of the best workmanship. They may be attached to flat surfaces, such as store fronts, etc., and a lamp can be lowered and stopped at any point that is desired. Fig. 2 shows the mast arm with the lamp ready for lighting. The advantages claimed for this mast arm are economy in time, in rope used, in cost of poles, in suspension wire and in loop wire. It is manufactured by the Cardarelli Electric Light Crane Co., Sumter, S. C.

The Lane & Bodley Shafting Stand.

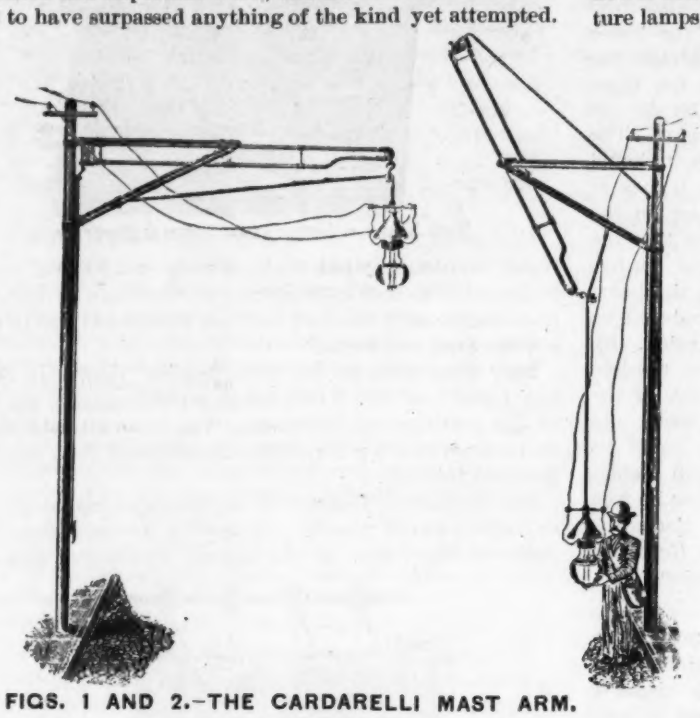
Those in charge of electric light stations have more to do with heavy line shafts at high speed than possibly

THE LANE AND BODLEY SHAFTING STAND.

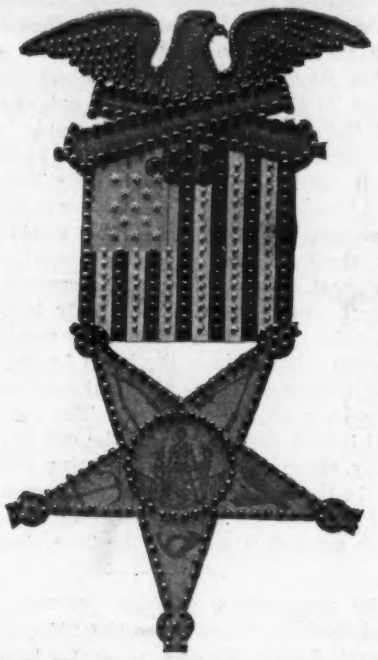
any other class of machine users. The accompanying illustration represents a new shafting stand, which has been put on the market by its manufacturers, the Lane & Bodley Company, Cincinnati, O., to supply the demands for a substantial stand with first-class self-oiling boxes easily adjusted and from which the boxes may be removed without removing the shaft, even though a bearing or pulley hub be on both sides. The bearings are made in length four times the diameter of shaft, and are lined with first quality bearing metal and supplied with a self-oiling chain feed. This new stand will undoubtedly meet with favor.

The Electrical Illumination at Washington.

The recent gathering of Grand Army veterans at Washington, D. C., afforded an excellent opportunity for extensive illuminating effects and, as might be expected, electricity played the prominent part. To the Decorative Lamp Department of the General Electric Company was intrusted this important work, and the results obtained are said to have surpassed anything of the kind yet attempted.



FIGS. 1 AND 2.—THE CARDARELLI MAST ARM.



THE ELECTRIC GRAND ARMY BADGE.

The interest in the reunion centred itself about Pennsylvania avenue, stretching from the Capitol to the Treasury and the Executive Mansion, and it was determined that this should also be the centre of the electrical display.

Running from near the Pennsylvania Railroad depot to the Treasury, pole lines were erected on both sides of the avenue. At short intervals along these two lines different corps badges were designed in small but intensely brilliant incandescent lamps, each corps badge being repeated three times at various points on the avenue in the national colors of red, white and blue. Above each corps badge the name of some notable fight in which the corps took conspicuous part, or well remembered sojourning place during the war, was written in electric lamps. At rarer intervals the portraits in oil of the leading war generals were suspended, each surrounded by a double border, the inner one of very small lamps, the outer of lamps of a larger size and higher candle power.

At the corner of Tenth street, in front of the Washington *Post*, was erected a splendid anchor, about twenty fee high, which when lighted blazed so brilliantly as to make it the most attractive piece on the avenue. In front of the Washington *Star* twin stars of red and blue were placed, and a patriotic device gleamed from within the office windows.

At the head of the avenue at the entrance to the White Lot was erected the most conspicuous design of the occasion. It was a monster fac-simile of the G. A. R. badge, 18 feet high, entirely made up of incandescent lamps. The eagle was outlined in white lamps, the cannon in blue, the stars and stripes in the regulation colors, and the pendent star in amber lamps. This piece was duplicated at the corner of Seventeenth street, below the White House. From the children's stand, at the head of the avenue, the name of Lincoln, in white lights, evoked pathetic reminiscences from the veterans.

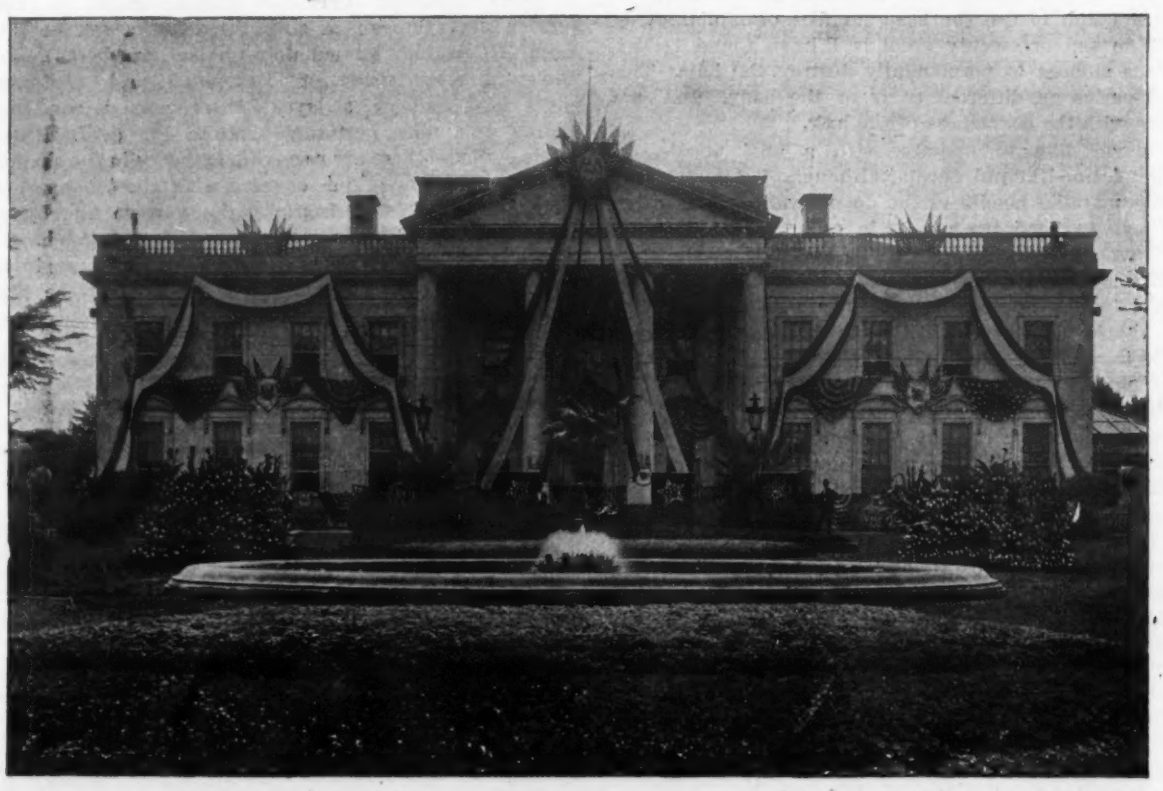
The illumination of the Treasury Building presented considerable difficulty. This was overcome by arranging along the cornice, at the top of the fluted columns, a line of colored arc lamps, which stretched from the entrance to the White Lot almost entirely around the building.

On the White House Lawn, in front of the Mansion, a fairy-like effect was produced; every bush, tree, fern and flower bed glistening with the light of innumerable miniature lamps, so suspended as to conceal all the mere practical details of installation. No less than 10 revolving stars, each of different design, were also set up here and constantly changing in design and color. Over each entrance to the Mansion was set a star of deep blue lamps.

A striking effect was obtained by the introduction of the search light. On the roof of the Washington Loan and Trust Company's building were set four 24-in. General Electric Company's projectors, built at Middletown, three facing the Capitol and one facing the Monument. During the evening the brilliant rays of light from these projectors shot the national colors on the clouds, or illuminated the surroundings of the city. The most powerful effects were obtained, however, when the whole four were brought to bear on the Capitol or on the Monument.

All this remarkable display was not obtained without great effort. Less than 30 days elapsed between the commencement of the work and the illumination. Poles had to be erected, and a whole three-wire system installed, drawing current from every available dynamo, public or private in the city. In fact, not enough current could be procured. Two G. A. R. badges, 63 corps badges, the same number of mottoes and names, and special devices such as the anchor and stars had to be designed and executed. Some idea of the work can be gained from the fact that over 25,000 incandescent lamps were used in the illumination, as well as over 100 arc lamps.

Credit for the success of the illumination is to be rendered to Mr. A. D. Page and to Mr. F. Clarke, the Washington representative, who were materially assisted by Mr. Fanshawe and Mr. McAllister, both skillful designers. The search lights were in charge of Mr. Gragg.



ELECTRIC ILLUMINATION AT WASHINGTON DURING THE GRAND ARMY REUNION.

The "Success" Arc Lamp.

The lamp which is shown in the accompanying illustrations is designed with an idea of producing an artistic and ornamental piece of work which shall replace the somewhat crude and cumbersome arc lamp which is in quite general use at the present day. It is especially intended for interior lighting, work for which the ordinary arc lamp is not well suited.

In Fig. 1 is seen the type which is employed for inside work. It is ordinarily 36 in. in length, but it can, if necessary, be shortened to 22 in. The lamp for outdoor use, as shown in Fig. 2, is somewhat shorter, having a length of 32 in. The mechanism of the lamp can be seen in Fig. 3. By an ingenious device a single eight-hour lamp is converted into a double or fourteen-hour lamp, and this result has been obtained by introducing a hollow

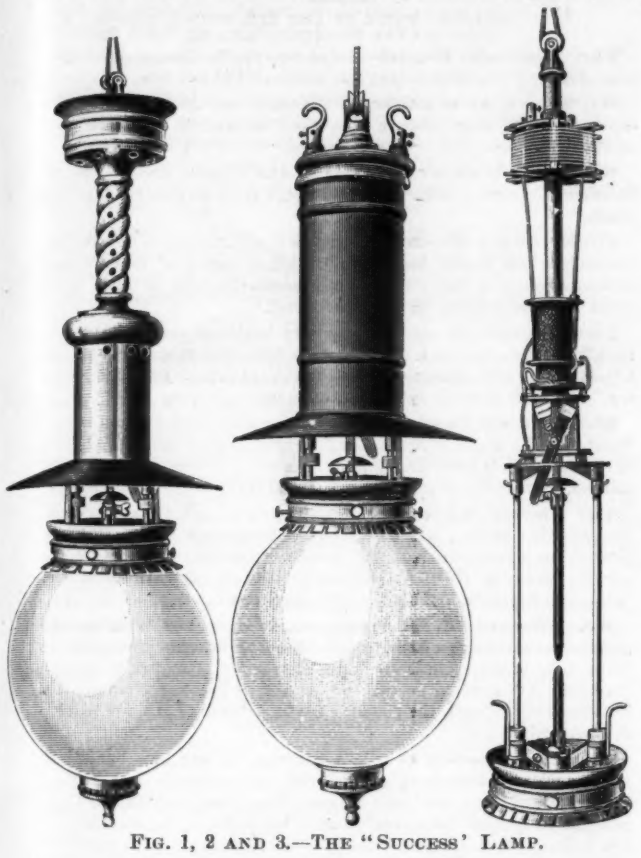
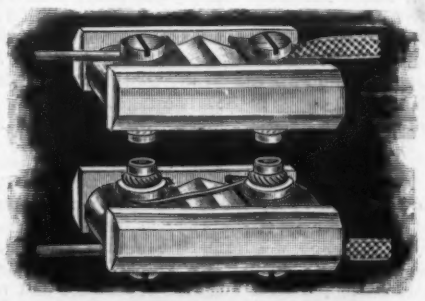


FIG. 1, 2 AND 3.—THE "SUCCESS' LAMP.

lower carbon holder with a bayonet tripod cap, the lower carbon being fed upward from this tube by a spiral spring coiled beneath it.

Simplicity has been aimed at in the design of the lamp mechanism, and as a result it contains no compensating spring or dash pot. The carbon rack is fed by a simple clock train, and is raised or lowered by the difference in pull of the main and shunt coils. The carbons are normally separated by the weight of the solenoid core, which has a pawl upon its lower end that plays into the teeth of the pinion and lifts the rack. When the current is turned on the shunt coil lifts this core, releases the pinion, and the carbons come together, the main coil then immediately separates them and starts the arc. For use in isolated plants or in electric street railway circuits, where the potential varies widely, an extra resistance is provided which is automatically cut in in case of the lamp going out, so as to save the shunt coil from burning out. It is practically impossible for the mechanism of the lamp to get out of adjustment, even in the hands of the most careless trimmer. Particular attention is paid to the insulation of the lamp so there is no danger in handling all exposed parts, and the resistances are so protected by fireproof material and so well ventilated that overheating will not occur.

Each lamp is provided with a specially designed patent snap switch. The lamps are wound for from seven to



THE LIGHTNING BUG CUT-OUT.

eight amperes and 45 volts. They may be run singly, two in series, five in series, or ten in series from the outside wires of an Edison three-wire circuit.

The "Success" arc lamp has been placed on the market by Mr. S. L. Phillips, 120 Liberty street, New York, and will undoubtedly prove worthy of its name.

New "Lightning Bug" Fixture Cut-Out.

The accompanying illustration shows a new fixture cut-out, the invention of Mr. Duane N. Gleason, of the E. P. Gleason Manufacturing Company, which this company is manufacturing and placing upon the market.

The "Lightning Bug," as the new fixture is called, possesses some features which are quite new. The leading-in and leading-out wires are secured under the flat screw heads, as shown in one of the illustrations. These screws are inserted into and pass through brass strips on each end of the cut-out; the strips, being bent U shape, the screw enters it near each edge and serves to keep the brass in position on the porcelain block. On the reverse side of the cut-out will be seen the fuse wire secured by a washer and nut to each of the terminals of the leading in and out wires, the fuse wire being inserted independently and without disturbing either of the main wires. This feature is very important, as many know who have tried to fuse an old style cut-out in which the fuse and main wires are loosened when one of the terminal screws is slackened up. In the "Lightning Bug" the main wires need never be disturbed at their terminals for fusing after once being placed in position.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Oct. 1, 1892.

New York General Financial Market.—"Tight money" is the bear cry just at the present time. Call loans were made as high as 8 per cent. this week, while the ruling current rate is from 5 to 6 per cent. It is caused by the almost unprecedented movement of currency to the West, to provide for crop shipments and a revival of industrial enterprises. During the period from Aug. 20 to Sept. 24, deposits in New York banks decreased $13,889,200. The banks and trust companies in this centre are getting tired of holding this interior money all of every summer when it is hard to loan, and then lose it in the fall, and have to pay gold into the treasury therefor. The net loss to the banks for the week ending Sept. 30, was $4,324,000. The cholera scare is a thing of the past. The corn crop is beyond danger from frost; railroads are showing large increases in earnings; still the market, beyond a few sporadic attempts, fails to respond. Tight money, if such becomes pronounced, will curtail the volume of speculation. Just at the present time, however, it is not a controlling condition. The real cause of our lethargy is to be found on the other side of water. England is not importing our gold, to be sure, but only because the rates of exchange are pronouncedly in our favor. The financial condition of England just at the present time is very bad. Our McKinley law has stagnated her manufacturing industries, banks are failing, building and loan societies suspending with nominal assets and real estate depreciating in value. Workmen are leaving the country. Capital is fearful of investment, and remains hoarded. The English holdings of American securities are only nominal, and, worse still for our market, there is no disposition to increase them. The belief prevails in many sections that we are on the eve of a pronounced bull movement; that it will be based upon the World's Fair, the settlement of campaign issues, and, last but not least, a bi-metallic international agreement on the money question. There is ground for this roseate view.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Oct. 1, 1892, and the range for the week in New York.

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Low-est.	High-est.	Bid.	Ask'd.
American District Tel....	100	3,825,000	....	....	59¼	61
American Tel. & Cable..	100	14,000,000	86	87	85½	87½
Central & So. Am. Tel....	100	6,000,000	....	....	....	....
Commercial Cables.....	100	7,716,000	157	164	161	165
Gold Stock & Tel.....	100	5,000,000	..	....	100	103
Bonds.....	500	500,000	....	....	100	..
Postal Tel. & Cable.....	...	10,000,000	....	....	62	64
Southern & Atlantic Tel..	25	948,775	....	....	78	84
Western Union Tel.....	100	86,199 852	95¼	95¾	95⅛	95⅛
Real estate bonds.....	1,000	1,219,000	....	....	....	..
Debenture bonds.....	1,000	4,920,000	....	....	....	....
Collateral Trust 5's....	1,000	8,181,000	....	....	....	....
North American.....	100	39.767,200	12¼	13	12⅛	12⅜
Brush Ill. Co. of N. Y.....	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y.,....	100	6,500,000	101	102¼	101	102
" " 1sts.....	...	.....	105¼	105¾	...	
Edison El. Il. of Brooklyn.	100	750,000	....	....	85	90
" " " " Chicago..	100	750,000	....	....	130	145
" " " " Boston...	...	.....	....	....	115	125
Edison El. Lt. Europe....	1,000	2,000,000	....	....	2	6
" Bonds.....	...	30,000	....	....	65	80
Edison Ore Milling Co....	...	2,000,000	....	....	15	20
East River El Light.....	100	1,000,000	....	....	....	65
General Electric.....	1,000	50,000,000	112¼	114¾	113	113¾
Debenture 5's.....	....	.....	104	104¼	....	....
Automatic Exhibition Co.	...	2,500,000	..	....	3	5
Mt. Morris Electric.....	...	500,000	....	....	....	65
N. E. Phonograph.....	...	2,000,000	....	....	2	4
N. Y. Phonograph.....	...	2,000,000	....	....	2	5
North American Phonograph.....	...	2,000,000	....	....	4	6
Westinghouse Elec. & Mfg. Co. 1st p. 7 per cent. Cum.....	50	3,717,253	101	102¼	101	102½
E. & M. Co. Assg.....	50	5.038,116	77	78	79½	80

NEW YORK ELECTRICAL STOCK MARKET.

In General.—The past has been a quiet week in this class of securities. However, it has not been without its features. Western Union was unusually quiet, giving rise to the belief that Mr. Gould's friends' attention was turned to the affairs of the Western Traffic Association (now in a very bad way) and distributing bull tips on his Missouri Pacific. Values were fairly steady, and closed fairly firm. The tightness of money, if it continues or becomes more pronounced, will be reflected in this market first by a curtailment of operations. Stocks that are active are largely dealt in on speculation. Speculators cannot afford to carry blocks of stock with money at or above 6 per cent. This condition will apply more particularly to the non-dividend paying securities, and may cause some unloading. We believe that under present conditions the market will hold its own next week. A revival in the general list would carry it upward. There was a falling off in bond transactions, showing a scarcity of money.

Western Union.—This stock has been more quiet than in months, and probably for reasons stated preceding. It shows no weakness, however, and will probably lead an upward turn in a movement based upon better industrial conditions throughout the country. There are few who realize how closely interwoven in our nation's industrial fabric Western Union really is. It reaches every hamlet. The prosperity of "Squash Corners" is just as important to its welfare (proportionally) as that of New York. The World's Fair is going to stimulate business in every corner of the United States. The telegraph companies will feel it first, the railroads next. Both will profit thereby, and the increased business is almost sure to be reflected in quotations. The new plan for the stock dividend issue will be out this month.

General Electric.—This stock has unmistakably been assigned a place among the "specialties." It bobs up and down with painful regularity, such movement being prompted by the course of the general market. Bear raids, bull movements, stop orders, puts, calls and tips are the order of the day. The starting point this week was 114, the close 112½. If history repeats herself the movement next week will be the reverse. Thirty-eight thousand dollars of its 5's debenture bonds sold at 104@104¼ against 103¼@104 of last week. This advance in the bonds against a decline in the stock is suggestive in showing that the tendency of the latter on investment buying is upward, and that the downward movement of the former is fictitious.

Commercial Cable.—After a quiet of over a month this stock surprised its friends by securing an advance of 7 points on a week's transactions, in small lots. It is one of the few stocks on the list which is in a few hands. These holders can do with it about as they please, and in the absence of more definite data it is fair to assume that the recent advance is based upon increased earnings.

Westinghouse.—This stock is a favorite with financial writers throughout the East. They have showered encomiums upon it during the past two weeks. Where there is so complete a unanimity of favorable expressions, it is well to bank on it. We believe that Westinghouse is in excellent shape and that it will some day surprise even its sanguine friends. It scored advances, the E. & M. assenting certificates selling at 77@78, and the preferred stock at 101 o 102¼.

North American.—The highest quotation reached in a month was 13 of last week. It weakened a fraction toward the close. Friends of the company continue to prophecy a bright future and higher prices for the stock.

WALL STREET NOTES.

Edison Lamp Patent.—We are informed by Messrs. Eaton & Lewis, attorneys for the Edison company, that a decision from the Court of Appeals in the celebrated incandescent electric lamp case is expected during the first part of October.

The Value of Westinghouse Stock.—The press of the country during the past six months has been filled with notices complimentary to the Westinghouse company and its management. Mr. George Westinghouse, Jr., who is really the Westinghouse company, inasmuch as he has brought it to its present excellent physical and financial condition, is the centre of interest in the electrical world just at the present time. During the past year and a half his time has been thoroughly occupied in reorganizing and straightening out the somewhat tangled state of affairs brought about by the Baring failure. This has all been completed, and he is now at liberty to use his powerful energies in pushing the business into new and competing fields. His contemporaries are awakening to the fact that he is proving a formidable competitor. Besides possessing inventive genius, capacity for work, untiring energy and clear cut, high toned business methods, he is not experimenting as a manufacturer, but is thoroughly conversant with the ground which he is now traversing. An example of his ability is to be found in the Westinghouse Air Brake Company, capitalized at $5,000,000, par $50. The price of the stock is $140, or on the par of $100, $280. Net earnings last year were $2,400,000, an increase of $700,000, or 40 per cent., over the previous year. Out of this, 35 per cent. was paid in dividends, leaving a surplus for the year of $659,000, and a total cash surplus of $1,250,000. In this connection the remark of Mr. Westinghouse made a few days ago is pertinent: "I know the Westinghouse Electric Company is a more valuable property, share for share, than the Air Brake, and I will prove it to be by showing larger net earnings in the future." It is claimed that Westinghouse is making 15 per cent. on the capital at the present time, and it is paying 7 per cent. on the preferred stock. It is said to be only a question of a short time before the payment of dividends on the common stock will be commenced.

New Securities Listed.—The Governing Committee of the Stock Exchange has authorized the following listing of electric securities:

The Westinghouse Electric and Manufacturing Company—5,236 shares, par $50 of preferred stock. Also 10,454 shares of assenting stock. The committee on stock list is empowered to add this stock to the list from time to time.

Edison Electric Illuminating Company, of Brooklyn—$1,500,000 of capital stock and $500,000 of first mortgage 5% gold bonds, payable October, 1940, interest payable April and October, redeemable at 110 and interest after October 1, 1900, and part of an issue of $2,500,000. The net earnings in 1890 were $34,583; 1891, $59,232; eight months of 1892, $50,362. The balance sheet shows the property account to be valued at $1,240,361. The company has $40,681 bills receivable, $58,555 supplies on hand, and about $194,000 in cash. Accounts payable amount to $20,914.

Long Distance Telephone.—A Chicago special says that a long distance telephone line between Chicago and New York will be completed within a few weeks. It is already working between New York and South Bend, Ind.

Sir J. Whitaker Ellis, ex-Lord Mayor of London, is in Boston for the purpose of inspecting that city's electric street car system.

Electrolytic copper during the past two or three years has won for itself a permanent place in the markets of the country. The time was when the manufacturers of electric wire and of the finer class of sheet goods were compelled to use Lake copper, owing to the fact that the metal refined from ores—the only substitute—was unsuited in texture and properties of conductivity. By the electrolytic treatment of copper many of these deficiencies have been eradicated, and the product is now found to be an excellent substitute in many cases for Lake brands. The cry has been that it was crowding the latter out of the market, owing to the less cost of production, and the fact that it is handled by interests antagonistic to those which produce the Lake copper. Producers of Lake copper do not regard it in this light. One of the most prominent expresses the belief that were it not for the electrolytic product there would not be enough Lake to meet demand. He acknowledged that it has caused a slight decrease in the price of Lake, but believes that before long it will benefit the Lake market to a material degree, and in this way: The cause of the periodic depression in the copper trade, since the failure of the French syndicate, has been the excessive amounts of copper produced from the ore and matte by refining. In order to dispose of this holders have sold it so low as to set the pace for quotations. Upon the occasion of every upward turn in the general market, prompted by a better demand, large stocks of these inferior brands would be thrown into consumptive channels at low prices. This has practically put the trade in the hands of smelters. The electrolytic treating of copper, formerly refined by furnaces, gives a superior and at the same time more costly product. This decreases the low priced stock, and substitutes therefor one which costs nearly as much as Lake. The result is that while it is afforded a better market, it must be kept within a certain fractional distance of Lake in order that its margin of profit may be maintained.

Jay Gould Buys Western Union Stock.—Friends of Mr. Jay Gould are reported as saying that he has added 20 per cent. to his holdings of Western Union during the recent bull movement.

The Copper Market continues weak and unsatisfactory to all but buyers. Round lots of Lake were sold as low as 11c. The companies claim to be holding for 11.20c., and not anxious to sell even at that figure. Consumers are indifferent and appear to have fair sized stocks on hand. We do not look for any change for the better in a week.

BOSTON, Oct. 1, 1892.

The General Market.—The market of the past week may be characterized as almost entirely a traders' market, in which the arbitrage business has been very large, and investors have seemed to stand aloof and have had little or no interest in placing legitimate orders with their dealers. Neither bears nor bulls dare to deal extensively, and prices are practically at a standstill. From day to day there is more or less fluctuation, but it is not the result ant of any permanent movement or underlying condition, simply the operations of the brokers. The quotations show little change during the week. The industrials have about maintained their natural strength, and have figured largely in the transactions of the Exchange.

General Electric stock rallied during the first part of the week to 114¾ and it was thought to be a good purchase for the higher prices that it reached some weeks ago, but it still has some enemies, and in a short time it was sold down to 112¾ on sales not sufficiently large to affect a stock if it were on strong foundations. The insiders are buyers, even if they fail sometimes to give it needed support. The preferred stock is quoted occasionally on very small sales at 118⅝. The latest quotations on the five per cent. bonds are 102½.

Westinghouse is strong and active, and well supported on this market. The bulls on this stock evidently believe that figures do not belie facts, from the way they publish broadcast the different operations of the company, giving it an apparently superior condition. The stock responds well to these statements, and is proving to be about the most attractive industrial on the list. The quotations show an advance of about three points for the week, having reached 40, and still better figures are promised.

Detroit Electric stock fell with a heavy thump to 4¾, recovering later to 5⅛, when it was reported here that the directors had voted to pass the regular quarterly dividend. This had not been expected, even by the Eastern directors, and does not seem to coincide with published reports of the company's condition and business outlook. It has given some parties cheap stock any way, even if no other result was obtained by the action.

In local stocks West End has been quiet at recent and unchanged figures. There has been no movement to note in this for some weeks. Sales average about 71¾, a low figure for the real value of this stock. Bell Telephone and the other telephone stocks are very quiet, and quoted only by actual sales for investment.

Among the copper stocks Boston & Montana had a sudden rise to 32, but in a speedy reaction lost all that it had gained. This is about the only active copper stock on the market, and all reports from the inside and current gossip promise higher figures in the near future.

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec.—Series C	sh	40,000	8¾	....	8¾	9
Thomson-Houston Elec.—Series D	sh	120,000	8	....	7⅞	8
Thomson Elec. Weld	100	1,000,000	....	....	....	....
Thomson European Elec. Weld	100	1,500,000	....	....	10	10½
Westinghouse Elec.—New Com.	..	6,000,000	40	37½	38½	39
Westinghouse Elec.—Pfd.	..	4,000,000	51	50	50¼	51
General Electric	..	30,067,200	114⅞	112½	112⅛	112½
" " Pfd	..	4,136,300	119	118⅝	..	118½
Fort Wayne Elec.	25	4,000,000	12¾	12⅝	12½	12¾
Fort Wayne Elec.—Ser. A.	sh	80,000	8	....	7⅞	8
Detroit Elec	10	750,000	6⅞	4¾	5¼	5⅜
West End St. Ry. Co.—Com	50	7,150,000	73	71⅝	71⅞	72
West End St. Ry. Co.—Pfd	50	6,400,000	87½	87⅛	87	87½
American Bell Tel	100	15,000,000*	202	198½	198	199
Erie Tel. & Tel. Co.	..	4,800,000	45⅞	45¾	45½	46
Mexican Tel. Co.	10	1,280,000	....	....	1	1.10
New Eng. Tel. & Tel. Co.	..	10,304,600	60	57½	61	....
Tropical Tel. Co.	10	400,000	....	....	....	20c.

* Ex dividend.

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stock furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.	Electrical Stocks:	Bid.	Ask'd.
Chicago	214	....	Chicago Arc Light & Power Co.	100	104
Central Union	58	60	Chicago Edison Co	150	..

NEW INCORPORATIONS.

The Schuylkill Traction Company, of Ashland, Pa., capital stock $10,000, has been incorporated to operate passenger railways by electrical or other means. J. F. Bailey, C. E. Winters and F. E. Bailey are the promoters.

The Dawson Electric Light and Power Company, of Dawson, Pa., capital stock $20,000, has been formed to supply light, heat and power by electricity to that town. Philip G. Cochran, John S. Mewmyer and Bert Neville are the promoters.

The Jefferson Electric Light and Power Company, of Punxsutawney, Pa., capital stock $6,000, has been organized to supply light, heat and power by electricity. S. E. Wilson, L. E. Myers and M. J. Dinsmore, are those directly interested.

The Sierra Water and Power Company, of Los Angeles, Cal., capital stock $200,000, has been started to deal in electrical and other powers, etc. Geo. A. Haskell, Los Angeles; Albert J. Wallace and Frank S. Wallace, of Pasadena, Cal., are the promoters.

The Minneapolis General Electric Company, of Minneapolis, Minn., capital stock $2,500,000, has been formed to generate and furnish electricity for all purposes. The promoters are E. S. Corser, A. B. Barton, A. Kelly, C. H. Prior, A. M. Robertson and J. W. Griffin.

The Commercial Electric Company, of Indianapolis, Ind., capital stock $20,000, has been formed to manufacture and sell all kinds of electrical machinery and instruments; also to erect power plants, etc. The promoters are Jos. R. Evans, S. L. Hadley and A. D. Adams.

The Electric Manufacturing Company, of Portland, Me., capital stock $25,000, has been formed to manufacture and deal in electrical appliances. Wm. M. Thayer, Boston, Mass.; J. H. Drummond, and J. H. Drummond, Jr., both of Portland, Me., are the incorporators.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Oct. 3, 1892.

Mr. D. A. Andrews, Jr., of the Pettingell Andrews Company, of Boston, Mass., made us a pleasant call last week.

Mr. D. A. Ford, of the Ford & Washburn Storelectro Company, Cleveland, O., was in New York on business last week.

Mr. Charles D. Shain has been appointed sales agent, with offices in New York City, for the Siemens & Halske Electrical Company, of Chicago.

The Perkins Electric Lamp Company on Oct. 1 will remove its office from Room 110, first floor, to Room 401, on the fourth floor of the Bennett Building.

The Beacon Vacuum Pump and Electrical Company, of Boston, Mass., has opened a New York office and stock room in the Central Building, 141 Liberty street.

Mr. M. W. Gleason, the manager of the Gleason Manufacturing Company's glass works at Brooklyn and Ravenswood, N. Y., has just returned by the Fuerst Bismarck from a flying trip to Europe.

Mr. Frederick Allen Wilkie has accepted the position of general agent for the Craighead & Kuetz Manufacturing Company, of Ballardale, Mass., and is introducing the new arc lamp called the "C. K." manufactured by them.

Mr. G. A. Wells, Jr., for some time past electrical engineer for the B. F. Sturtevant Company, of Jamaica Plains, Mass., has resigned to accept the position of first assistant engineer with the C. & C. Motor Company of this city.

Mr. E. E. Higgins, who went to Europe a few months ago, has resigned his position with the Short Electric Company of Cleveland, and is to go into business for himself in New York. He sails for home on Oct. 12.

The Mather Electric Company, owing to its rapid increase in business, has been obliged to secure larger offices and will remove from its present quarters in the Bennett Building to the fourth floor of the same building on Oct. 1.

W. R. Brixey, 203 Broadway, New York City, and 225 Dearborn street, Chicago, has succeeded to the Day's Kerite insulated wire and cable business. Mr. Brixey, after 14 years' experience as superintendent and general manager in the manufacture of these celebrated cables, is well fitted to assume charge of the business.

The Telegraphers' Mutual Benefit Association will hold its annual meeting in the Western Union Building, 195 Broadway, New York, at 4 o'clock on Wednesday, Nov. 16, 1892. Several quite important amendments to the by-laws have been proposed and will be submitted to the meeting, and it is hoped that the attendance will be large.

The New York Electrical Society has been cordially invited to attend the sessions of the American Electro-Therapeutic Association, and to inspect the Exhibition of Electro-Therapeutic Apparatus to be held in connection therewith, at the Academy of Medicine, No. 17 West Forty-third street, on Oct. 4, 5 and 6. The exhibition will be open during these days from 10 A. M. until sunset at room 40, adjoining that of the meeting room of the Association. No ticket of admission will be required. L. H. H.

PHILADELPHIA NOTES.

PHILADELPHIA, Oct. 1, 1892.

The J. G. Brill Company, the well known car builders will probably exhibit a couple of trucks and one car body, which they are now building, at the National Street Railway Convention in Cleveland, O. This, however, will depend upon the recovery of Mr. J. A. Brill.

The Lamokin Car Works, of Philadelphia, will send an 18-foot body palace electric car to the National Street Railway Convention at Cleveland, where the company will be represented by its contracting agent, Mr. G. E. Pratt, and its superintendent, Mr. Henry Cochran.

Mr. J. A. Brill, vice-president of the J. G. Brill Company, is confined to his bed with an attack of malarial typhoid fever. Mr. Brill recently returned from Europe, where he escaped the cholera only to be stricken down by another dangerous disease immediately upon his arrival home.

W. H. Weston & Co. have just completed a very handsome switchboard for F. P. Little & Co., of Buffalo, N. Y. The board is 6 × 4 ft. and upon it are placed 25 of the W. H. Weston & Co.'s push-brake switches. The workmanship is of the very best and reflects much credit upon the company, which is now so rushed with orders that it is necessary to work night and day.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Oct. 1, 1892.

The Perkins Electric Lamp Company, Boston, Mass., reports its sales for the last month as being very satisfactory.

Mr. R. R. Hammond, vice-president of the Supply Manufacturing Company, of Pittsburgh, Pa., was a recent visitor to the Hub.

Mr. Israel B. Oliver has removed from 84 Lincoln street, Boston, to 63 High Rock street, Lynn, Mass., and has entered into the manufacture of electric batteries and portable electric fixtures.

The Whitney Electrical Instrument Company has removed its office from Hartford street to 146 Franklin street, Boston.

The Boston Gear Works is preparing a new list of iron gears, which will be very complete. It will be ready in the near future.

The W. S. Hill Company, Boston, have recently manufactured a handsome rheostat for the Electric Forging Company. It is at present working on a special order, a number of revolving switches.

The Chapman Valve Company, of Indian Orchard, Boston reports a steady growth in its electrical department. It manufactures a bronze seat valve specially adapted for the uses of electric light stations.

The Germania Electric Company, Boston, Mass., manufacturers of incandescent lamps, motors, etc., is just introducing its new reflector shade, together with an extensive line of fancy designed lamps in various colors.

Fred H. Whipple, formerly publisher of Whipple's Reports, is confined in jail at Pittsfield, Mass. He is charged with obtaining money under false pretenses, the action being brought by C. G. Tompkins and others, and has been bound over to await the action of the grand jury.

The Boston Society of Operative Electricians meets at the American House, on the first and third Wednesdays of each month. The secretary, Mr. Ralph Vose, would be pleased to supply those interested in the society with passes to the meetings, in the hope that they may join. The society intends shortly to have its own quarters.

The Peabody town electric plant, the first to be established under chapter 350 of the acts of 1891, was successfully placed in operation this week. The entire town, except West Peabody, is lighted by 150 arc lights of 1,200 c. p. The plant cost $50,000, and consists of a brick power station, 150-h. p. engine, two 125-h. p. boilers, and four dynamos with a capacity of 194 arc lamps.

The Sawtell Company has opened offices on Franklin street, and will deal in electrical supplies, motors, etc. It is also the sole selling agent of the Davis Electrical Works. It makes a specialty of renewing burnt out incandescent lamps. The company is also a large manufacturer of incandescent lamps, and claims for them high efficiency, long life and very little blackening. Its new catalogue is now ready.

Sir J. W. Ellis, ex-Lord Mayor of London, England, who is visiting Boston for the purpose of making an inspection of the West End Street Railroad of this city, in company with F. S. Pearson, chief engineer, and C. S. Sergeant, second vice-president, visited the central power station of the company. The party made a trip in the General Electric Company's special car over the principal division of the electric system and afterward visited the works of the General Electric Company at Lynn. Mr. Ellis expressed his highest admiration of what he had seen. W. R. W.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Oct. 1, 1892.

The Emerson Electric Company, St. Louis, Mo., has placed a revolving alternating fan motor on the market.

Mr. Frank A. Wunder, of Chicago, was looking after the interest of the Fort Wayne Electric Company in St. Louis this week.

Mr. H. A. Wagner, manager of the Wagner Electric Manufacturing Company, returned to St. Louis from an Eastern trip this week.

The Standard Electric Company, of Chicago, is moving its offices into the Home Insurance Building, corner of LaSalle and Adams streets, in order to be more accessible, and to give more room at the factory in South Canal street.

George Cutter's electric specialty business has increased so rapidly that he has been compelled to take the three large offices adjoining his well known quarters on the third floor of "The Rookery," and he is now nicely settled in his new quarters.

The Elkhart Converter is meeting with good success in the West, and the Electric Appliance Company, which controls its sale in that section, is receiving a large number of orders and has been obliged, on account of the demand, to run its factory night and day.

The Electric Thermostat Company, 645 Temple Court, Minneapolis, Minn., is sending out a handsome new catalogue containing descriptions of its standard automatic regulators for use on furnaces, steam or hot water heaters, and wherever the automatic regulation of temperature is desired.

Mr. Edward E. Higgins, rumor says, has resigned the general managership of the Short Electric Railway Company, to enter into business in New York City. Mr. Higgins is now in Europe, but wherever he may go, and in whatever channels his fortunes may be cast, the good wishes of a legion of friends will accompany him.

The Little electrical bell is winning its way into every possible nook and corner of commercial and domestic application. Thousands of them are in daily use. The Electrical Supply Company recently received a single order for 20,000 of its Eureka iron box bells, and also reports an unusual demand for its Diamond carbon batteries.

A Recording Voltmeter.—Mr. James I. Ayer, general manager of the Municipal Electric Light and Power Company, of St. Louis, has a Freres alternating current self-recording voltmeter in his office, and so connected in circuit that a perfect record is secured of any fluctuations in the voltage on any circuit during the entire twenty-four hours.

Among the out-of-town visitors in Chicago this week are Mr. D. A. Andrews, Jr., of Pettingell-Andrews Company, Boston; Capt. Willard L. Candee, of the Okonite Company, New York; Mr. Charles M. Rockmel, of the Buckeye Electric Company, Cleveland, O.; Mr. C. D. Jones, of Jones & Hovey, Independence, Ia., and Mr. F. B. H. Paine, en route from the Pacific slope to Boston.

The Wagner Electric Manufacturing Company, of St. Louis, Mo., is now nicely settled in its new factory, 2017-2023 Lucas place, just west of, and on the opposite side of the street from, the Missouri Electric Light and Power Company's station. With the full equipment of machine tools and the largely increased floor space the company will soon be in position to place its alternating current power motors on the market and to supply any of the smaller sizes from 1 h. p. to 5 h. p., on demand. The manufacture of Wagner fan motors and other specialties will also be pushed.

The St. Louis Exposition.—Among the exhibitors are the Columbia Lamp Company, with a handsome display of plain and colored bulbs; the Emerson Electric Company, with one of its revolving alternating current fan motors, and a full line of switches, cut-outs, cross-overs, and other lighting and railway specialties, as well as their standard alternating fan motor; the Rose Electric Light Supply Company, with a variety of second-hand dynamos and motors so handsomely painted and repaired that they readily pass for new machines; the Shultz Belting Company, with wide rolls of belting stacked high, and everything thereto pertaining; the St. Louis Electrical Supply Company, with a handsome sample-board of staple goods, as well as of its well known specialties; the Otto gas engine doing giant's work in the section adjoining the very attractive and instructive display of the Municipal Electric Lighting and Power Company, that is intended primarily to interest the general public in the advantages that follow the use of electricity for domestic purposes. F. DE L.

SOME CINCINNATI JOTTINGS.

CINCINNATI, Oct. 1, 1892.

The Lodge & Shipley Tool Company is a new firm organized to manufacture a special electric lathe and similar light machinery. Mr. Lodge was formerly connected with the Lodge & Davis Machine Tool Company. Mr. Shipley is a graduate of Yale, with considerable practical business experience and many good qualities that will stand him in good stead in his new and responsible position.

Eelctric matters are active in Cincinnati all along the line. Mr. Nowotny is perfecting a primary battery from which he expects splendid results. Mr. La Boiteaux is experimenting with a new form of small motor with a view to simplifying the mechanism and increasing the efficiency. The electric elevator of the Cincinnati Electric Elevator Company is being improved, and when put upon the market is expected to give considerably better satisfaction than the old form.

Post & Co., who recently sold their interest in the Standard Electrical Works to Mr. E. V. Cherry and others, have just turned over the electrical part of their business to a new firm, composed of Mr. Oliver Kinzie, for many years connected with Post & Co., and Mr. S. W. Glover, formerly the representative of the Western Electric Company, but for the past year or so in business for himself in Cincinnati as an electrical engineer and contractor and dealer in electrical supplies.

Mr. Edward Lunken has obtained formal judicial permission to shorten his name from the more lengthy Lunkenheimer. Mr. Lunken is an inveterate inventor. Though still quite a young man, his inventions and patents are legion. One of the most important of these, if not indeed, the most important, is a valve that for compactness and simplicity is a veritable marvel. When this valve shall be put upon the market a few months hence it will attract considerable attention.

A new gas engine, especially designed and adapted for electrical work, is promised. Mr. Bogart, who has had a long practical experience in this field, is at work on it, also one in Covington. This engine promises when perfected to be an important step in advance in a field in which America can hardly be said to quite keep pace with the effete monarchies of Europe. The readers of THE ELECTRICAL WORLD will probably hear more of Mr. Bogart and his ingenious gas engine.

The Post-Glover Company, as the consolidated firm is called, starts business under favorable auspices. Not only will they handle all the electric light and electric railway specialties of Post & Co., but they have the agency for such well known Eastern manufacturers as the Interior Conduit Company and Benedict & Burnham, as well as for the Standard Electrical Company, of Chicago, and the Columbia and Packard lamp companies. They also have the best wishes of the trade for their success.

Mr. Isaac Kinzie, president of Post & Co., does not in the least appreciate the efforts of a certain Mr. Scott, who has been doing his best to flood this section of the moral vineyard with forged checks, purporting to be drawn to his order by Post & Co. Fortunately the enterprising but not very clever forger does not appear to have so far made much by thus taking Mr. Kinzie's name in vain, and as the daily papers have chronicled his shortcomings in this direction, it is hardly likely that he will in the future.

In addition to these companies the Queen City Electric Light Company (controlled by the Edison company) does a nice little lighting business. The Queen City company recently put in a 50-light arc machine for doing commercial lighting. The Jones Brothers & Company also do considerable of a lighting business, and are constantly extending. If competition be the life of trade Cincinnati may be congratulated upon the fact that the lighting of her streets and buildings is not likely in the near future to suffer from the blighting effects of monopolistic sway!

The aluminium patent is the subject of litigation in Cincinnati at the present moment. The suit for infringement brought by the Pittsburgh Reduction Company against the Cowles Electric Smelting and Aluminium Company, based on the patent granted to C. S. Hall, was called in the United States Court in this city on Monday of this week before Judges Taft and Ricks. George H. Christy and Thomas Bakewell appear for the plaintiffs, and Dr. Leggatt and George Sherman for the defendants. Should the patent be sustained the Pittsburgh company will have a monopoly of the business. Should the defendants win any one will have the right to manufacture aluminium by the same process.

The public lighting of Cincinnati, the preparations for which have been going on for some time, will soon be an accomplished fact. The first district (about one-fourth of the city) will, it is thought, be started up by Nov. 1. There will be 2,000 lamps installed, and work is now going rapidly on putting in the lamp-posts. On Wednesday of this week City Electrician Robb Mackie was kept busy making out permits for the erection of the poles. These are to be iron at the base, surmounted by cedar poles. As readers of THE ELECTRICAL WORLD know, the contract for this city lighting has been given to the Edison Electric Light Company, and the apparatus to be used is that of the Standard Electric Company, of Chicago.

The Card Motor Company is doing so extensive a business that it has arranged to take the entire building as soon as the lease of the occupant of the fourth floor expires, which will be in a short time. Mr. Wilshire and Mr. Jantz are particularly pleased with the plant recently installed by the Card company in the new and elaborate Alms Hotel in Cincinnati. This plant consists of 2 Card dynamos of 600 lights each, 2 50-h. p. Rice engines, a 4-h. p. Card motor driving a 48-inch Wing fan, and a 2-h. p. motor driving a 30-inch fan. A similar plant was installed by the Card company in McAlpine's dry goods house, and a smaller one of 300 lights in the Telephone Exchange. In addition to the large number of Card motors in use 200 Card dynamos are running in Cincinnati alone.

The number of lighting companies in the Queen City is greater than some suppose. The original First Cincinnati Edison Company acquired the exclusive rights for the important territory in the heart of the city bounded by Pearl, Elm, Fifth and Walnut streets. This company, the Brush Electric Light Company and the Hauss company are now all under the control of the Cincinnati Electric Light Company, of which Gen. Andrew Hickenloopen, president of the Cincinnati Gas Company, is the head. The Edison Electric Light Company, with the rights for all of Cincinnati outside of the territory assigned to the First Cincinnati Edison Company, is a vigorous competitor of Brother Hickenloopen's companies, and rather got ahead of that eminent citizen in the matter of the public lighting.

The kindred interests are also progressing. Houston, Stanwood & Gamble are manufacturing over in Covington a slide valve engine that is highly spoken of for its efficiency and economy for driving dynamos. It is already largely in use for electric lighting, and will be more extensively employed when its merits become better known. Mr. Houston for many years held the position of superintendent of one of the well known engine shops in this city. Mr. Stanwood, the designer of the engine, is an eminent mechanical engineer and the director of the active and progressive Technical School of Cincinnati. Mr. Gamble is of the famous soap manufacturing establishment of Proctor & Gamble. Three such men combining their energies are very likely to make a success of anything they undertake.

A new underground system for electric railway wires was exhibited in the Chamber of Commerce Building on Tuesday. It is the invention of Mr. E. W. Mitchell and is thus described: The feed wire, heavily insulated, is hidden beneath the surface of the track in an iron conduit a foot square. A few inches above it is a vibrating wire, upon which hang at short intervals "plungers." From the motor beneath the car and down through the slab extends an iron rod, ending in a set of wheels, which ride the vibrating wire. This wire is in sections of two feet each. The weight of the car bears the vibrating wire down sufficiently to bring the "plungers" in contact with the feed wire, and the current passes up through a wire in the iron rod to the motor, and the power is generated. A company has been formed to exploit the invention. It is to be called the Mitchell-Thompson Underground Electric Conductor Company. Judge A. C. Thompson, of Portsmouth, O., is president of the company, and Mr. Mitchell secretary.

CLEVELAND CHRONICLES.

CLEVELAND, O., Oct. 1, 1892.

The Short Electric Company as usual is full of business; 25 equipments for Wilkesbarre, Pa.; six for Columbia, S. C., and four for Syracuse, N. Y., are among the orders recently received. Professor Short says his latest form of gearless motor, to be exhibited at the Cleveland Street Railway Convention, Oct. 19, 20 and 21, will be a beauty. It is with this type of gearless motor that the Professor proposes to equip a section of the New York Elevated Railway to demonstrate to Colonel Hain's satisfaction the efficiency and economy of electric traction for the "L." Mr. Hazleton has the immediate charge of the preparation for the Short exhibit before the American Street Railway Association, and he is going to have a display worthy of the occasion and of the position occupied by the Short company in this active and important department of electricity. The amount of work accomplished by Mr. Hazleton and Professor Short is astonishing. They make an excellent team.

The Brush Electric Company has done more business during September than in any month in a long time. The prospects are, however, that the October business will be far ahead of that of September. Among the orders received during the past few days may be mentioned a city plant for Marshall, Mich., consisting of one 30-arc machine and a 600-light alternator; a 1,000 lighter for Elmwood, Ill.; four 65-light machines and 150 lamps ordered by Mr. Geo. H. Roe, of the California Electric Light Company, San Francisco. The company is now 2,400 lamps behind its orders. The new Brush station in Indianapolis proves to be very handsome. It will have 750 arc lights, 14 No. 8 machines, and a 26 circuit switchboard. Mr. Gilbert's Boston Brush station will also be well worthy the attention of those who like to keep up with the progress in central station construction. Mr. Gilbert had an unfortunate experience with fire, but now it would seem as if a fire in his station would be an utter impossibility. Mr. Potter and Mr. Hammil are to be congratulated on the manner in which they keep up the Brush Electric Company's volume of business.

Ford & Washburn are turning out lots of motors. They recently put a 10-h. p. motor in the Bradley Block to run two elevators, one freight and the other passenger, and a 15-h. p. machine to run a shoe factory in the same building. The Store Fixture Manufacturing Company, of Cleveland, also has a 35-light Ford & Washburn dynamo, and the Anzeiger Publishing Company a 20 h. p. motor. These motors are all 500 volts, and are run by the street railway current. The Ford & Washburn storage battery is now being regularly manufactured. Orders were recently filled for Sandusky, O., and Brooklyn, N. Y.

The Graves Arc Lamp, which has been manufactured in Cleveland for the past two years, has met with so much success that Mr. Graves, the inventor and head of the W. D. Graves Electrical and Mfg. Company, has greatly enlarged his facilities for turning out the lamp. Formerly the Graves lamp was only made for low tension work. Now it is also made for high tension currents. Over 100 of these lamps have been installed in the immediate vicinity of Cleveland within the past month; 21 of them in the William Rogers dry goods house; 10 in H. M. Brown's dry goods house, and 30 of them by the Oberlin Gas and Electric Ligat Company. Mr. Graves is considerably behind in his orders for the Graves transformers, another of his specialties.

Mr. W. H. Lawrence and the National Carbon Company have been buying about $70,000 worth of real estate at Rockport. The deeds were filed at the county clerk's office yesterday (Friday). Extensive new works are to be put up for the Carbon company, and employés of the company will probably use some of the land for homes.

The Street Railway Convention, which opens on the 19th, promises to be the usual success. Every available space at the Hollender is taken, and the room clerk is experiencing the difficulty that Josh Billings encountered when he tried to get a No. 8 foot into a No. 6 shoe. The Hollender is a fine hotel and well managed, and a big effort will be made to render everybody comfortable. Those, however, who are going to the convention, and who have not yet secured accommodations should communicate with the hotel clerk at once. The Short, the General Electric and the Westinghouse will make the largest exhibits. Mr. Brill, however, will be there; so will the Rochester Car Wheel Works, and many others who have been prominent features of former conventions. On account of the dedicatory services in connection with the World's Fair at Chicago on the 21st inst., it is likely that some of the Western—particularly of Chicago—delegates and supply men will not remain in Cleveland after the evening of the 20th. Chicago men would consider it an unpardonable offense to be away from the Windy City on so memorable an occasion; and so, for that matter, would some of the rest of us, for the Fair is a national one, and we all take or ought to take a national interest and pride in its success.

News of the Week.

THE ELECTRIC LIGHT.

Elmore, O., is asking for electric lights.

Laredo, Tex.—Work on the electric street lighting plant has commenced.

The Fort Wayne Electric Lighting Company, on May 1 last, was incorporated in Baltimore with Mr. J. Frank Morrison as general manager, Mr. W. Russell, formerly of the Brush company, as superintendent, and Mr. W. D. Kennedy, chief of incandescent department. Since its incorporation the company has added to its plant, or is in process of adding, the following machinery: 650 h. p. of Zell boilers; 775 h. p. of Buckeye engines; four 2,000-light Slattery alternators; one 1,000-light Thomson-Houston alternator; one 650-light Thomson-Houston alternator, and two 80 and one 60-light Wood arc dynamos. The company is at present engaged only in commercial lighting, but upon the expiration of the Brush company's contracts with the city it will make a bid for street lighting.

THE ELECTRIC RAILWAY.

The Pittsburgh (Pa.) & West End Railroad Company has taken out a permit to erect a power house at the south end of the Point Bridge on Carson street, Pittsburgh, at a cost of $30,000.

Scranton, Pa.—A Philadelphia syndicate, which includes Edward E. Denniston, John P. Ilsey, Stephen B. Haas, C. Ford Stevens, and James Richardson, Jr., has arranged for the purchase of all the electric lines of the People's Street Railway Company in this city. They have already taken steps to secure a charter, and as soon as they obtain it they will assume charge of the road under the corporation name of the Scranton Traction Company.

MISCELLANEOUS NOTE.

The Electric Retouching Pencil, which was illustrated and desccibed in the last issue of THE ELECTRICAL WORLD, was devised, perfected, and is solely manufactured by Mr. A. L. Bogart, of 22 Union Square, New York City. The E. & H. T. Anthony Company, which was mentioned in the description of the apparatus, are the sole agents for its distribution and sale, and not its manufacturers, as was stated.

Industrial and Trade Notes.

Thomas Yearsley, 123 North Third street, Philadelphia, reports that he is very busy and is compelled to operate his works both night and day.

Owen Walsh, 105 Walker street, New York City, dealer in speaking tubes and electrical supplies, is about to place upon the market some very interesting electrical specialties, which will, no doubt, attract considerable attention.

The Washburn & Moen Manufacturing Company, Worcester, Mass., has issued a little folder setting forth the merits of the Salamander wire, which showed such excellent results at a recent test in New York City before the electrical insurance inspectors and experts.

The Berlin Iron Bridge Company, of East Berlin, Conn., is building a new machine shop for the Mather Electric Company, at South Manchester, Conn. The building will be 52 ft. wide by 150 ft. long, the central portion being 35 ft. wide, controlled by a 15-ton traveling crane. The design is a combination of iron and wood, all the heavier parts of the building being of iron.

The Bryant Electric Company has placed in its Chicago warehouse one of the largest and most complete lines of electric light switches, cut-outs and sockets, in the West. Realizing the importance of prompt shipments, the company has secured such a stock that there will be no danger of any delay in the filling of orders. The office of the warerooms is at 1,522 Monadnock Building.

Thomas Dallett & Company, manufacturers of the Billberg motors and dynamos, report very successful sales of their apparatus, among which may be mentioned the following: Wm. Sellers & Co., Philadelphia, 15 h. p.; Philadelphia Electric Phototype Company, 5 h. p.; J. L. Lind & Co., Philadelphia, 3 h. p.; W. L. Beckham & Son, Philadelphia, 2 h. p.; F. A. Bradley & Co., Philadelphia, 5 h. p.

Mr. Tallmadge Delafield has just returned from Marion, Ind., where he has been superintending the installation of the Thomson-Houston plant which the Delafield Construction Company, of 15 Cortlandt street, New York City, has been putting in. The boilers for the plant were furnished by the Phœnix Iron Works, and the whole installation is very complete and the work most satisfactory. The company reports that it is very busy at present.

The Gleason Manufacturing Company has been compelled to start up its Ravenswood factory in order to fill the large number of orders which are continually coming in for its glass ware, and especially for electric lights. This company has purchased the Brooklyn Glass Bending Works on North Second street, Brooklyn, and is now in a position to bend all kinds of sheet glass. A piece of ¼-inch plate glass turned out last week for a swell front store on Fulton street, Brooklyn, measured 36 square feet

The Capsule Batteries, which are manufactured by the Nassau Electrical Company, 112 White street, New York City, have been employed for the past six months at the torpedo station, Newport, R. I., with such satisfactory results that more have been ordered. It is highly essential for this sort of work that a battery be used which cannot possibly be injured, and the Capsule battery is so small that each gunner can carry his own cells with him. The Capsule battery has also been applied with equal success to mining and blasting.

W. S. Chesley & Co., electrical engineers and contractors, 136 Liberty street, New York City, have found it necessary on account of their increased business to enlarge their present quarters, and are now fitting up a new machine shop at 24 Morris street, Jersey City, N. J., near the Cortlandt street ferry, where they will have facilities for repairing all kinds of electric light and power apparatus. This company buys apparatus outright or receives it on consignment, repairs it if necessary, and sells it on commission at the owner's price. It still has an agency for the Easton Electric Company, of Brooklyn.

The Western Electric Company, of Chicago, has just issued a pocket edition of its illustrated general catalogue, which is very artistically gotten up. It contains all the matter in the larger catalogue but in a more compact and convenient form. The various pieces of apparatus and instruments which this company manufactures are too numerous to mention, as it handles everything from an annunciator or a push button to a galvanometer or dynamo. In addition to descriptions and very complete illustrations the catalogue contains some matter of general interest in the form of tables and gauges and reflects great credit upon the company.

The Nowotny Electric Company, 303 Fifth street, Cincinnati, O., the well-known manufacturer of electrical specialties, has developed a primary battery that promises to be of considerable practical use in places where current for dynamos is not accessible. These batteries are especially designed for lighting purposes, running electric launches, ventilating fans, and are made in three sizes with a capacity, it is claimed, of from 100 to 1,000 ampère hours per cell. One of the important features is the entire absence, as the company claims, from local action when the circuit is open. The battery very much resembles the Leclanché cell in operation, except that there is no perceptible polarization when the circuit is closed.

The Pelton Water Wheel Company has several important contracts in hand for electric power transmission stations in the West, among which may be mentioned the Standard Con. Mining Company—a plant of 250-h. p. capacity, the power from which is to be transmitted a distance of 13 miles to the mills of the company located at Bodie, Cal.; the People's Electric Power Company, at Aspen, Colo.—a 750-h. p. plant designed as a central distributing station for general mining use, involving a transmission of about three miles; and the Walla Walla Electric Light and Power Company, at Walla Walla, Wash.—a 400-h. p. plant intended for light and power purposes, from which a street railroad is to be run.

Messrs. J. Jones & Son, 39 Vesey street, New York City, state that the report that has been in circulation that this firm is about to close its business at the above address is entirely without foundation. On the contrary, the company has added to its business facilities by acquiring the controlling interest in a large and well equipped machine shop at 60 and 62 Murray street, known as the J. M. Lambert Manufacturing Company, where its manufacturing will be carried on in the futnre. The removal of this part of their business has left on their hands at 39 Vesey street a well fitted up machine shop which is for sale, and this, no doubt, gave rise to the above mentioned report. The company not only has better facilities for its machine shop work by this removal, but it also has more room for the supply and construction department than at the old uarters in Vesey street.

The Pennsylvania Electric Engineering Company, of Philadelphia, agents of the Western Electric Company, of New York and Chicago, is securing its full share of business in that

section of the country. Among the important contracts which it has recently secured may be mentioned the following: A complete plant in the Philadelphia & Reading terminal depot, Conover and Markets streets, Philadelphia, consisting of 300 2,000-c. p. arc lamps and the entire construction work and wiring; a plant for the Steelton, Pa., Electric Light and Power Company, including 2,500 16-c. p. incandescent lamps, two 2,000 volt dynamos and complete station equipment, including transformers, lamps, etc.; two 500-light multipolar dynamos for the Commonwealth Hotel, Harrisburg, Pa. Mr. J. P. Gaylord, president of the company, and Mr. L. R. Shooks, treasurer, are both young and active men.

The Scott Electrical Manfacturing Company is one of the busiest of New York firms and reports that all departments are crowded with orders. This company has devoted a great deal of time, money and energy to the development of marine search lights and is the manufacturer of the now well known Huntington search and position light. This apparatus, while being small, light and easily handled, has an illumination of extraordinary penetration, throwing a light powerful enough to distinguish buoys at a distance of over half a mile, and owing to the peculiar shape of the parabolic reflector used the lamp meets the pilot's demand for a narrow beam of light. The Scott company has recently been experimenting with a search lamp of still greater power than any hitherto attempted and with most gratifying results. A short time ago late workers in the lower part of the city noted a powerful ray of light that struck the towers of the Bridge and was lost in the distance beyond Greenpoint. The company was testing at 26 Liberty street a 9,000-c. p. light for the Plant line S. S. Olivette, a steamer running in the summer between Boston and Halifax, and in winter engaged in carrying passengers to the health resorts of Florida. The lamp will be used in navigating narrow channels where a powerful search light is of the utmost importance, and is one of the finest ever manufactured in this country. Among the other new steamers using the Huntington light we note the R. Peck, the pride of the New Haven S. S. Co., and the S. S. Lancaster of the Weems line.

The Ward Arc Lamp.—The Electric Construction and Supply Company, of New York and Chicago, has added another to its list of artistic catalogues, each one of which is more tastefully designed and more conveniently arranged than its predecessor. "Arc Lighting on Constant Potential Circuits: A discussion of the merits of the best and safest methods of arc lighting, accompanied by a description of the 'Ward' Arc Lamp for general and special purposes," is the title of the new catalogue. The introductory chapter gives a brief history of the evolution of the Ward arc lamp, but this lamp is already too well known to need more than the merest reference to its career. In chapter 2 the various forms of single carbon lamps are illustrated and described, while the following chapter treats of the Ward double carbon, short and twin lamps, with all of which types the public is already familiar. Ward ornamental arc lamps and the esthetics of arc lighting is the subject of chapter 4. One of the chief reasons why the arc light has not been used more for interior lighting is the fact that it was not ornamental. This objection, however, can no longer be urged. The Ward lamp, while combining the highest efficiency and durability, is above all artistic, and the types which are intended for interior work are of very ornamental design. The application of the Ward lamp to street railways and to alternating current circuits furnishes interesting matter for the text and illustrations of chapter 5, while the following two chapters discuss its use for photo-engraving and focusing work, and for theatrical and stereopticon and opthalmoscopic purposes. The Ward search light has justly obtained its reputation. Being primarily intended for incandescent circuits, this type of lamp is especially adapted for use as a search light on board of men-of-war or other ocean steamers. For use on steam yachts, launches and other small craft the Electric Construction and Supply Company has devised a special form of small search light, which possesses sufficient candle power, with facilities of concentration and penetration, while at the same time it presents an attractive appearance in keeping with its surroundings. The arc lamp is becoming more and more generally adapted for use on incandescent circuits and the Ward lamp no doubt will maintain in the future the high position which it has held in the past.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Having carefully examined Houston's Dictionary of Electrical Words, Terms and Phrases, "I have always found it to contain the information desired in plain and concise language," states Mr. Chas. Hempstead, of Fairhaven, Pa., in a recent communication regarding this new and valuable addition to the electrical literature of to-day.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

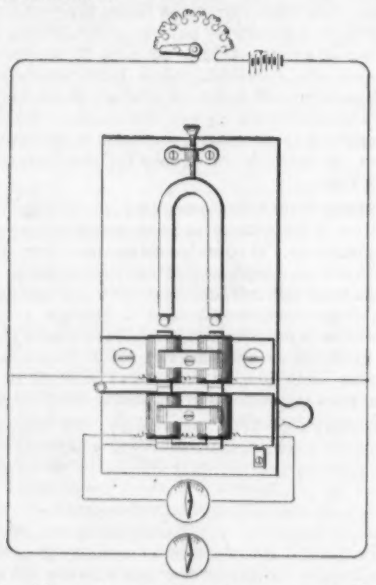
U. S. PATENTS ISSUED SEPT. 27, 1892.

483,124. Electric Heater; Thomas Ahearn, Ottawa, Canada. Application filed April 4, 1892. The combination of a tube, strips of asbestos laid on the tube longitudinally, strips of mica laid on the asbestos strips, a coil of wire or strip of refractory metal of electric conductive power wound on the strips and its terminals connected with leads, an outer tube inclosing the coil and leaving an annular space, a filling of powdered non-combustible non-electric conducting material in the annular space, insulated packing rings closing the ends of the annular space, covers having lugs on the packing rings, and bolts passing through these lugs and holding the covers together.

483,162. Automatic Coin-Actuated Telephone; Franz Müller, Berlin, Germany. Application filed Aug. 25, 1891. A telephone consisting of coin-conduit and chute having wheel segments projecting into the same and geared together, in combination with an electromagnet, having an armature, with a spring, and a carrier engaging into the uppermost wheel segment.

483,168. Method of Measuring the Strength of Magnets; Charles H. Rudd, Evanston, Ill. Application filed Nov. 6, 1891. This method consists in balancing the magnetic field of the magnet by a counter magnetic field generated by an electric current, measuring this current and comparing its value with the current required to balance a standard magnet. (See illustration.)

483,175. Test System for Multiple Switchboards; Charles E. Scribner, Chicago, Ill. Application filed Dec. 5, 1891. The combination with a telephone line having one limb or portion thereof permanently connected with the springs of the switches of the line and by the other limb or portion thereof with the frames or test-pieces of the same switches of a wire permanently connecting the limbs together at the central office, the connecting wire including a condenser.



No. 483,168.—Method of Measuring the Strength of Magnets.

483,189. Electric Meter; Addison G. Waterhouse, Hartford Conn. Application filed Jan. 4, 1892. This invention consists of a vessel adapted to hold a fluid electrolyte provided with electrodes, a gas collector placed over one or both of these electrodes, the collector being provided with a tube or gas-passage leading from the upper interior of the gas collector, having the elements within itself for discharging the gas from the collector after a certain amount has been collected, in combination with a float placed within the gas collector and provided with connections through which the movement of the float is imparted to a recording mechanism. (See illustration.)

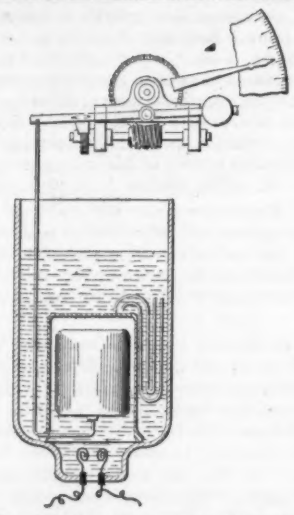
483,204. Electric Locomotive; Norman C. Bassett, Lynn, Mass. Application filed April 1, 1891. The combination with an electric locomotive, of a motor and means for suspending it from the frame of the locomotive, comprising links extending to the centre of gravity of the motor. (See illustration.)

483,231. Circuit Closer for Railroad Crossing Signal Mechanism; Irvin W. Loy and Richard O'Toole, Mechanicstown, Md. Application filed Nov. 6, 1891. The combination of a track bar located by the side of a railroad track with a lever pivoted near the same, one end of which protrudes beneath the trackbar and the other end of which operates a spring-controlled fly wheel, and a pair of contact points which are the terminals of an electric circuit containing a bell and which are maintained out of contact with one another by the fly wheel when it is at rest under the influence of its spring.

483,235. Electric Cut-Out and Switch Box; Llewellyn B. McMunn, Cromwell, N. Dak. Application filed April 5, 1892. The combination, in an electric cut-out and switch box, of insulated plates with insulating blocks arranged to slide thereon and carrying conductor bars in engagement with the plates, a lever for moving the blocks, dynamo circuit terminals arranged opposite the same, and a short-circuiting bar extending between the dynamo circuit terminals and adapted to be lifted therefrom by the insulated blocks.

483,272. Means for Controlling the Operation of Mechanisms; Henry E. Vincing, Roseville, N. J. Application filed Feb. 27, 1892. An electric controlling device consisting of a pin or lever actuated by a disc and intermediate mechanism caused to rotate in alternately opposite directions by mechanisms operated by a number of successive electrical impulses of one polarity, then a break in the circuit, and then a number of successive electrical impulses of an opposite polarity.

483,285. Electric Cable; Theodore Guilleaume, Cologne, Germany. Application filed May 5, 1892. In an electric cable, a strip of non-conducting material twisted about its own axis to form spiral grooves or air channels in which conductors may lie.



No. 483,189.—Electric Meter.

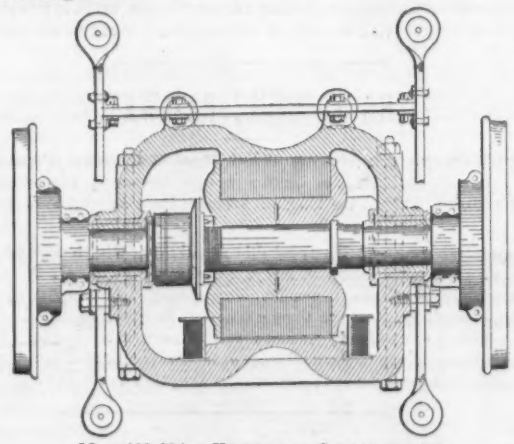
483,309. Electric Bell; Nelson H. Raymond, Buffalo, N. Y. Application filed Aug. 29, 1891. The combination, with a porcelain base of an electric bell, of an electromagnet having a frame seated in a recess in the front of the base and secured thereto by a suitable attaching device.

483,310. Electrical Annunciator; Nelson H. Raymond, Buffalo, N. Y. Application filed Sept. 26, 1891. The combination, in an electric annunciator, of a U-shaped sheet-metal frame, provided with stiffening wires at its edges and supported within a suitable inclosing case on the lugs fitting the interior of the trough, the magnet, and armature, pivoted on one of the stiffening wires, and the drop pivoted on the wire on the opposite edge of the frame.

483,316. Electric Snap-Switch; Seth Frank Alden, New Bedford, Mass. Application filed Feb. 1, 1892. This switch comprises in its construction terminals and a base support, vertical, plated, rectangularly arranged opposite plates being electrically tied or connected, each terminal plate being provided at or near one end with a locking pin or stud and a rotary shaft provided with a spring-impelled brush adapted to be brought successively into contact with the terminals, certain of the latter of which and the rotary shaft being embraced within an electrical circuit.

483,327. Coupling for Underground Wires; John J. Purcell, Washington, D. C. Application filed Feb. 16, 1892. The combination, with the two sections of an electrical conductor, of a sleeve upon the end of each section, the one having externally right-hand threads and the other externally left-hand threads, a nut having internal right and left-hand threads and a central external enlargement and receiving the sleeves, one of which fits snugly over the outer covering of the conductor and having external threads at its ends, the flanged nuts engaging the threads of the sleeve and fitted closely over the outer covering of the conductor, and packing rings between the ends of this sleeve and the outer ends of the nuts.

483,339. Thermostat; Ira F. Beers and Frederic C. Beers, of Elmira, N. Y. Application filed March 17, 1892. In a thermostat, the combination, with a bar mounted on a lever, of a second lever engaging therewith, a third lever secured at one end to the second lever, and at its other end to the arm on the post, and the indicating hand.



No. 483,204.—Electric Locomotive.

483,366. Electric-Railway System; Andrew L. Riker, New York. Application filed Dec. 22, 1891. The combination of a continuous hollow rail laid in sections magnetically insulated from each other and lines, except at the upper portion, with insulating material, a service-conductor inclosed by the rail and resting normally on the insulating lining out of contact with the rail proper, and a vehicle provided with magnets adapted to lift the conductor into contact with the rail.

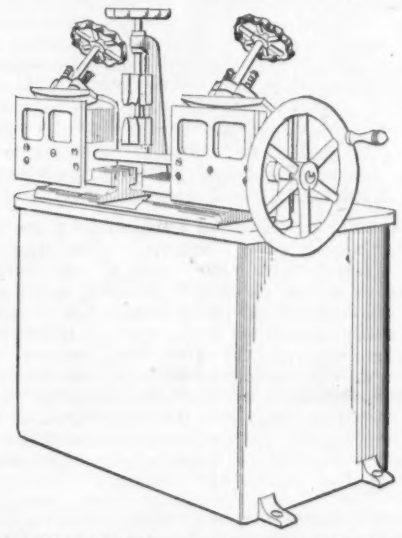
483,388. Trolley Track Hanger for Electric Railways; William Q. Prewitt, Lexington, Ky. Application filed Oct. 17, 1891. In a trolley track hanger, two clamping members channeled between their adjacent edges to receive the track, and provided with an underlying flexible support, the members having laterally extended securing flanges.

483,423. Process of Electric Welding; Charles L. Coffin, Detroit, Mich. Application filed Dec. 11, 1891. A process of welding metals electrically, consisting in first heating the article to be welded by passing an electric current therethrough, then upsetting each of the articles an appreciable distance back of the place of welding and not at the plane of junction, then pressing the articles together to form a weld, and finally completing the weld by swaging, hammering, etc. (See illustration.)

483,124. Electric Metal-Working Device; Charles L. Coffin, Detroit, Mich. Application filed Dec. 11, 1891. In an apparatus for electrically working metal, the combination of two movable conductors, means for forcing the conductors together or apart, a clamp and die located between the conductors, and means for passing an electric current through the conductors and an article held in the clamp.

483,425. Process of Electric Metal-Welding; Charles L. Coffin, Detroit, Mich. Application filed Jan. 21, 1892. This process consists of electrically filling a seam in a plate with molten metal, consisting in connecting the plate with one pole of a source of electricity, supporting over the seam a plate of metal with which the seam is to be filled at an angle with the first-named plate, connecting the last named plate with the other pole of the electric generator, and forming a voltaic arc between the plates.

483,426. Process of Electric Metal-Heating; Charles L. Coffin, Detroit, Mich. Application filed Jan. 26, 1892. This process consists of electrically heating metal of varying cross-section, consisting in simultaneously subjecting the metal at different points to the action of separate voltaic arcs, whose heating power varies in approximate proportion to the respective cross-sections of the material at the points to which the arcs are applied.



No. 483,423.—Process of Electric Welding.

483,427. Electric Metal-Working; Charles L. Coffin, Detroit, Mich. Application filed Feb. 6, 1892. An apparatus for electrically welding continuous metal bands, consisting of a converter having a broken secondary and means for inserting the piece to be welded within the core of the transformer, so as to complete the secondary.

483,428. Process of Electric Metal-Working; Charles L. Coffin, Detroit, Mich. Application filed Feb. 8, 1892. The process of heating metal, consisting in subjecting the opposite sides of the metal simultaneously to the action of voltaic arcs alternated in position.

483,431. Electric Motor; William M. Dresskell, Brainard, Minn. Application filed June 25, 1891. In an electric motor, a commutator formed of series of discs or contact-pieces insulated from each other and a series of conductors provided with contact springs for forming electric contacts with the several discs.

483,491. Electric Railway Conductor; Rudolph M. Hunter, Philadelphia, Pa. Application filed Sept. 23, 1886. A suspended working conductor having a smooth or practically smooth under surface with a series of supports for the conductor connecting with it on the upper part thereof, a traveling vehicle, an electric motor on the vehicle, and a collecting device making a traveling contact upon the under side of the conductor for supplying electric current to the motor, a motor circuit under the car, and a hand regulator to control the motor in the motor circuit.

483,506. Test System for Multiple Switchboards; Oro A. Bell, New York. Application filed Sept. 30, 1891. The combination with a telephone line of spring jacks having two line-springs and two back contacts, one line-spring and its back contact of each spring-jack being included in each side of the line circuit, and test pieces upon each spring-jack, connected to the line circuit between the different back contacts of the last jack of the series, whereby the test pieces are disconnected from the line circuit when a plug is inserted into any jack.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.

U. S. CIRCUIT COURT OF APPEALS.

Second Circuit Before Lacombe and Shipman, Circuit Judges.

THE EDISON ELECTRIC LIGHT COMPANY, *Respondent.*
vs.
THE UNITED STATES ELECTRIC LIGHTING COMPANY, *Appellant.*

Appeal from a decree of the Circuit Court, Southern District of New York, granting an injunction with accounting for profits and damages. The suit was originally brought on three patents: No. 223,898, dated Jan. 27, 1880; No. 227,229, dated May 4, 1880; No. 265,777, dated Oct. 10, 1882.

By stipulation the bill was amended by withdrawing the last two patents. The cause came on for hearing before Judge Wallace on pleadings and proofs, with the result above indicated; the defendant appealed. The facts are sufficiently indicated in the opinion.

Lacombe, C. J.: On Jan. 27, 1880, under an application filed Nov. 4, 1879, letters patent No. 223,898 were issued to Thomas A. Edison, and by subsequent assignments passed to the complainant. The four clauses of the patent are as follows:

1. An electric lamp for giving light by incandescence, consisting of a filament of carbon of high resistance, made as described, and secured to metalic wires as set forth.

2. The combination of carbon filaments with a receiver made entirely of glass, and conductors passing through the glass, and from which receiver the air is exhausted for the purpose set forth.

3. A carbon filament or strip coiled and connected to electric conductors so that only a portion of the surface of such carbon conductors should be exposed for radiating light as set forth.

4. The method herein described of securing the platina contact wires to the carbon filament and carbonizing of the whole in a closed chamber substantially as set forth.

In the lamp made by the defendant the carbon conductor is not coiled as indicated in the third claim, nor is it secured as indicated in the fourth, nor does complainant contend that either of these clauses is infringed. The Circuit Court holds that the first claim was by its phraseology limited to lamps, in which (among other things) the leading-in wires are secured to the filament according to the method of the patent; that is, by cement carbonized *in situ*, and that as defendant used clamps for this purpose it does not infringe. This construction of the first claim has been acquiesced in by the complainant, which has not appealed from the decision. There remains for consideration only the second claim.

The defendant's burner is of carbon so small in cross-section that by the ordinary usage of common speech it may be fairly called a "filament;" the receiver which contains the burner is made entirely of glass; the conductors which connect with the burner pass through the glass; and from the receiver the air is exhausted. Defendant contends, however, that the specifications of the patent and the prior state of the art require that this second be so limited in construction that defendant's apparatus will not fall within its terms, and that unless so limited such claim is directly anticipated or untenable as not involving patentable novelty.

Lamps devised to give light by means of the electric current are broadly divided into two groups, the arc and the incandescent. In the former two conductors or electrodes are so arranged that when in operation they are slightly separated with their axes in the same vertical line. The current leaps across the intervening space, tearing off and partially vaporizing particles from the opposite ends of the electrodes and developing heat and light in the ends of the electrodes and in the finer particles between them. In order to provide a current that shall be as effective as possible at the place where it develops light, not only the conductors, which bring it from the source of supply, but also the electrodes themselves forming part of the conducting circuit are devised to present but small resistance to the passage of the current. The effective resistance begins when the break in the circuit is reached. In an incandescent lamp there is no break in the circuit, but there is introduced into it a piece of poorly conducting material, which is so arranged that its resistance to the passage of the current will develop heat sufficient to bring it to the state of incandescence. The wires which conduct the current to the place where it is thus developed by resistance are so devised as to present but small resistance to its passage. The effective resistance begins where the piece of poorly conducting material (the burner or illuminant) is placed, and the lamp expires when the burner is consumed, breaks or wears away. The longer the life of the burner the longer the life of the lamp and the more available it becomes for practical electric lighting.

The selection of materials for the various parts of the circuit thus formed, their manipulation, arrangement and operation have for many years occupied the attention of experimenters, and the results of their labors made public from time to time constitute the state of the art of incandescent electric lighting.

The patent sets forth that "The object of the invention is to produce electric lamps giving light by incandescence, which lamps have high resistance so as to allow of the practical sub-division of the electric light." By the phrase "sub-division of the electric light" is meant such a sub-division of the electric current that at several alternating foci supplied from the same source of electricity there shall be developed lines of moderate intensity—comparable to those given out by ordinary gas jets—and the problem to be solved required a system and apparatus which would admit of the development of these moderate lights in sufficient number and at so low a cost as to be commercially useful.

Prior to 1879 experimenters seemed to have reached the conclusion that success was to be obtained, if at all, by modifications of the arc lamp, but up to that time no lamp, arc or incandescent, had been given to the public which, with the means then existing for operating and distributing the electric current, accomplished this result. Since the date of the patent in suit electric lighting by lights of moderate intensity has become a commercial success. Subsequent improvements in the electrodes and in other parts of the system have undoubtedly contributed materially to its development, but the record evidently shows that with lamps such as the patent describes, constructed with the skill then known to the art and operated under the conditions admitted by the operating and conducting apparatus then existing, it became practical for one generator to operate a suitable number of lamps located at reasonable distances from it, and which at the same time were economical, durable and cheap enough to be commercially useful, and so simple and reliable that they could be manipulated by the public.

In view of the utter failure of the prior art to produce any such subdivision of the electric light, a lamp of this kind which was capable of economical use in factories, large buildings, and in smaller buildings contiguous to each other—in other words, available for isolated lighting—should be considered commercially successful, though further development were needed to enable it to compete with gas for domestic lighting on even approximately equal terms. What, then, was the contribution to this solution of the problem which Edison gave to the world by the patent in suit? Commercial and domestic exigencies required that the lamps should be so arranged that each derived its power independently from a common source, and not through another lamp, so that they could be individually lighted or extinguished at will, and the breaking down of a single lamp would not break the circuit. This is effected by what is called the "multiple arc" arrangement, the wires leading to and from each light being so connected with the main conductors as to form a separate circuit for each light. In this arrangement no greater electromotive force is required for a large number of translating devices than for a single one, the current being graduated to the number employed. The lower the resistance of each alternating conductor the greater the current it requires, and as their number is increased, their individual resistances remaining constant, the wires of the main conductors can be likewise increased—an increase which in the prior art soon involved such an expense for main conductors as to preclude commercial success.

The amount of heat developed by the passage of an electric current is greater as the flow of the current is greater. It is also greater as the resistance of the conductor is greater, and all electric conductors vary in resistance directly as their lengths and inversely as the cross-section. Conductors of different materials have also different specific resistances. The quantity of heat developed in a translating device is independent of—but the degree of heat (*i. e.*, the temperature) is dependent on—the extent of radiating surface. In the lamp shown in the patent these losses are availed of, ratios of resistance of the burner to the resistance of the entire circuit and to its own radiating surface being so graduated that a light of the required intensity is produced by the expenditure of so small an amount of current at each illuminant focus as to admit of main conductors sufficiently small and therefore sufficiently low priced to warrant the introduction of the system into public use.

It is not necessary to enter into any elaborate discussion of the prior state of the art so far as it bears upon the question of patentable novelty of such embodiment of a number of high resistances and small radiating surface. Irrespective of all patents or publications of others, the philosophy of this method of producing light is undoubtedly found stated clearly and sufficiently applied to the production of an incandescent platinum burner in Edison's French Patent No. 130,910, taken out May 28, 1879. Whether under section 4887 of the Revised Statutes that patent, embodying as it does his own invention, is sufficient, so far as Edison is concerned, a part of the prior art and to what extent in view of the prior art, that patent discloses patentable invention need not be determined upon this appeal, inasmuch as we are satisfied that there was invention in the substitution of the carbon of the patent in suit for the platinum of the French patent, even though all knowledge as to what should be the ratio of resistance to radiating surface were pointed out, either in the French patent or elsewhere in the art.

As stated above, conductors of different materials have different specific resistances. Without going into details it may be stated that among the metals platinum, including its alloys, is the only one which seems to have given promise of success for incandescent burners. With a method of preparation intended to remedy some of its defects it is the material of the French patent, although the first claim of that patent is, generally, for a continuous *metallic* conductor. The specific resistance of platinum is sufficiently high to admit of its being raised to incandescence by the electric current. When so raised it is not consumed in the presence of oxygen, but is fusible at a temperature slightly higher than that at which it becomes incandescent. To produce it, it has to be maintained so near the melting point that a slight fluctuation of the current above the normal strength destroys it, and a large part of the French patent is devoted to the description of methods and complicated apparatus called the "Thermo-regulator," intended to regulate the current so as to avoid any such raising of the temperature.

In his invention as described in the French patent Edison departed from the existing idea of burners of low resistance, declaring the commercial and scientific necessity of burners of high resistance, although they must be slender and presumably fragile, and attempted to find a method of protecting them from the effects of heat and of the atmospheres. It is said that the theretofore known laws of electricity should have taught everyone that an electric incandescent lamp must have a burner of small cross sections and small radiating surfaces. The electric laws have been known and have been recognized, but they did not tell how to protect the materials which would make efficient burners from the destructive effects of other sourses than electricity to which they must be subjected, in other words, they did not tell how to construct a lamp. Edison, in his French specification, followed the principle of high resistance to an extreme, made platinum burners with a resistance of 200 to 300 ohms and described the method by which they were to be prevented from speedy deterioration "by destroying or intercepting the atmospheric action; he freed them from occluded gases by subjecting them to a high degree of electrical heat in a vacuum and subsequently sealed them also in a vacuum." The platinum lamp did not achieve success. Inasmuch as carbon has a specific resistance from 200 to 400 times that of platinum (hard, dense carbon having a lower resistance than porous carbon), is practicably infusible, had been long before suggested as a translating device and used as such in many of the lamps devised by the prior art, it might be supposed that when one skilled in that art was seeking a substitute for the platinum wire, something which would by reason of high resistance and small radiating surface apply the philosophy disclosed in the French patent, and then admit of operation at a higher temperature without melting, he would have turned to carbon, but the record in this case clearly established the converse of this proposition. Carbon when exposed to the air at a temperature sufficient to produce incandescence undergoes combustion. To remedy this difficulty, earlier experimenters suggested inclosing the carbon burner in a glass globe from which the air and moisture were to be excluded. These globes were separable, to allow of replacement of the interior parts. We do not find the words "suitably sealed," used in the King patent (British, 1845, No. 10,919) to describe a modification of his lamp for use under water, sufficient warrant for the contention that its structure was to be so radically changed as to substitute a light and compact all glass globe with irremovable burner for the cumbrous apparatus with its column of mercury which he describes in detail.

Neither the inclosing chamber of Crookes, nor the Geissler tubes, though being all glass with wiring sealed in they would not leak, were used by the prior art to protect incandescent burners. By reason, in part, that that mode of construction with a spearable chamber, the vacua which the earlier experimenters sought to secure could not be maintained. Though subsequent improvements in exhaust pumps might give their apparatus a high initial vaccum, it would rapidly disappear in the leaking globe. It was against the oxygen or other carbon consuming gases that all prior inventors sought to protect the burner, and later inventors tried to accomplish the same result by filling the chamber with nitrogen or some other gas which was inert, *i. e.*, did not combine with the carbon the carbons themselves were also subjected to processes for making them harder, more tenacious, and series of carbons were arranged to be brought in operation successively without opening the camber, but one and all of these devices failed to secure stability in the carbon. An operation variously described as a "disintegration," "a wearing away," "a kind of evaporation," was soon fatal to the life of the burner. The record abundantly establishes the proposition that so far from turning to carbon for his first burner, which was to have so high a ratio of resistance to radiating surface, one skilled in the art would have been led by the teachings of that art to suppose that this instability would prove fatal to its use irrespective of the size of the burner. Especially is it true that the use of small carbons in the attentuated or filamentary form which Edison had indicated in the platinum patent would not have been thought of. Nor do we find any suggestions of Lane Fox either in his patents (British, Nos. 3,988, 4,043, 4,626, of 1878, 1,122, of 1879), or his other publications, any such appreciation of the cause of the disintegration of carbon or any such supposed method of preventing it as to controvert the conclusion that the art was looking elsewhere than to carbon for the burner, which should have a future. Certainly Lane Fox himself seems to have looked for success rather to his metallic alloys and his compounds operated in nitrogen or other suitable gas than to carbon in a perfect vacuum. The literature of the art fully sustains the statement of Mr Schwendlar quoted in the *Telegraphic Journal* in 1789 that "we can scarcely expect that the principle of incandescence will be made use of for practicable illumination," unless there be discovered a conductor without the defects of platinum, and "which does not combine at high temperature with oxygen."

In June, 1878, and January, 1879 (United States patents 205,144 and 211,262), Sawyer-Man indicated one of the causes which operated to produce this disintegration of the carbon, viz., "that some oxygen or other element for compounds remained in the lamp." The carbon "occluding sufficient air or oxygen to render its consumption a mere question of time," as "the least quantity of oxygen in a sealed lamp is sufficient to combust an indefinite quantity of carbon."

This they sought to remedy by heating the carbon pencils immersed in a hydrocarbon liquid to an extremely high temperature, thus producing a hard and dense carbon and one whose specific resistance was lowered by that very process. They also, while the globe was on the pump and nitrogen flowing into and out of it, heated the "carbon to incandescence, thus driving out all the impurities and occlnded gases which are carried out of the glass by the current of nitrogen." Believing that the deterioration of the carbon burner was due to the presence of occluded oxygen which escaped into a sealed chamber and "promoted combustion," they sought to secure stability by substituting for the oxygen they had forced out by heating on the pump, an atmosphere of nitrogen; that done they sealed their chamber, which seems to have been a separable one.

Edison had experimented with carbon before he devised the platinum lamp of his French patent. Subsequently to the date of that patent, apparently because that lamp did not seem to promise the success he hoped for, he again turned to carbon. In the course of his investigations he made a discovery as to the causes of "disintegration" of which he availed himself to devise a lamp, in which carbon, even in the filamentary form required for a burner, which ratio of resistance to radiating surface was such as to apply the philosophy pointed out in his French patent, could be maintained for a sufficient length of time and become a commercial succe s.

At the date of the application for the French patent he had apparently reached only the point that "pencils (not filaments)" "of carbon can also be freed from air in this manner and be brought to such a temperature that the carbon becomes pasty, and if it is then allowed to cool, it is very homogenous and hard." The knowledge that practical stability can be given to a carbon filament was not gained until October, 1879.

The patent in suit sets forth that therefore "light by incandescence has been obtained from rods of carbon of one to four ohms' resistance, placed in closed vessels, in which the atmospheric air has been replaced by gases that do not combine chemically with the carbon. The vessel holding the burner has been composed of glass cemented to a metallic base," or, as the evidence in this case shows, sometimes to a glass base. "The leading wires have always been large, so that their resistance shall be many times less than the burner, and, in general, the attempts of previous persons have been to reduce the resistance of the carbon rod. The disadvantages of following this practice are that a lamp having but one to four ohms' resistance cannot be worked in great numbers in multiple arc without the employment of main conductors of enormous dimensions; that, owing to the low resistance of the lamp, the leading wires must be of large dimensions and good conductors, and a glass globe cannot be kept tight at the place where the wires pass in and are cemented; hence the carbon is consumed, because there must be almost a perfect vacuum to render the carbon stable, especially when such carbon is small in mass and high in electrical resistance. The use of a gas in the receiver at the atmospheric pressure, although not attacking the carbon, seems to destroy it in time by 'air washings,' or the attrition produced by the rapid passage of the air over the slightly coherent, highly-heated surface of the carbon. I have reversed this practice. I have discovered that even a cotton thread properly carbonized and placed in a sealed glass bulb exhausted to one-millionth of an atmosphere offers from one hundred to five hundred ohms' resistance to the passage of the current, and that it is absolutely stable at very high temperatures." (Here follow further statements as to other carbon substances, and their manipulation.) "By using the carbon wire of such high resistance I am enabled to use fine platinum wires for leading wires, as they will have a small resistance compared to the burner, and hence will not heat or

crack the sealed vacuum bulb." (The burner being placed on the glass holder) "a glass bulb (is) blown over the whole, with a leading tube for exhaustion by a mercury pump. This tube when a high vacuum has been reached is hermetically sealed." "The invention consists of a light-giving body of carbon wire or sheets coiled or arranged in such a manner as to offer great resistance to the passage of the electric current, and at the same time present but a slight surface from which radiation can take place. The invention further consists in placing such burner of great resistance in a nearly perfect vacuum to prevent oxidation and injury to the conductor by the atmosphere. The current is conducted into the vacuum bulb through platina wires sealed into the glass." Edison's invention was practically made when he ascertained the heretofore unknown fact that carbon would stand high temperature, even when very attenuated, if operated in a high vacuum, without the phenomenon of disintegration. This fact he utilized by the means which he has described, a lamp having a filamentary carbon burner in a nearly perfect vacuum. Although all glass globes with leading wires passing through the glass and sealed into it had been used before to preserve the condition of the interior of a chamber from the effects of leakage at the joints, and although the prior art, including the French patent, indicated that subdivision of the electric light was to be obtained by the use of burners of high resistance and small radiating surface; and although pencils of carbon had been tried in imperfect vacua—and found wanting, in view of the teachings of the art as to the disintegration of carbon under the action of an electric current to still select that substance as a suitable material from which to construct a burner, much more attenuated than had ever been used before—reduced in size to the filamentary form, in which economy of construction requires that it must be used in order to avail of the philosophy of high resistance and small radiating surface—and so to combine old elements, that the disintegration due to "air washing," should be practically eliminated, and the burner thus become commercially stable. It is true that carbon burners still break down, that the improvements, neither of Edison nor of other inventors, have made them absolutely stable, and in a sense it may be said that Edison only made them more stable than they were before—that it is a mere matter of degree. But the degree of difference between carbons that lasted an hour and carbons that lasted hundreds of hours seems to have been precisely the difference between failure and success, and the combination which first achieved the result "long desired, sometimes sought, and never before attained," is a patentable invention.

It is also true that the combination and manipulation, which secured a practically perfect vacuum by heating the burner, while the exhaust pump was at work, and subsequently sealing the globe without introducing a foreign gas, is set out by Edison in his French patent as a means of effecting such a change in the condition of platinum as would permit of its being raised to higher temperatures, without rupture, cracking or diminution of weight, by volatilization. But the evidence shows that the platinum lamp did not achieve success, and we think there was manifest invention in the substitution of carbon, freed from occluded gases, and placed in a nearly perfect vacuum. The change of material involved a reorganization of the lamp, dispensing with the thermal-regulator, which was an essential part of the structure of the French patent; it developed new properties in the lamp by reason of the enormous differences between the resistances and the melting points of the two materials: it utilized the discovery of that cause ("air washing") of the instability of carbon, which seemed to preclude all hope of its future usefulness as an incandescent illuminant: finally and principally, by the substitution, there was presented the complete combination of elements, which for the first time in the art produced a practical electric light. We are of the opinion that on principle and under the authority such a substitution of material is invention.

Experts called for the defendant here testified that such change of material involved no invention, because the use, as a substitute for platinum of carbon of any size, operated in a vacuum, would be obvious to one skilled in the art. To this proposition we cannot assent. Sawyer and Man were skilled in the art, but even after they had learned how to force out the occluded gases and withdrew them from the lamp chamber they turned away from the vacuum, thus leading to their hands feeling no doubt that they were following the teachings of the art in seeking stability by the use not of the vacuum but of the nitrogen atmosphere.

Edison was skilled in the art, but after he had the nearly perfect vacuum of French patent secured against leaking by the all glass globe of Geissler and Crookes, it was only after months of patient and persistent experiment that he found in the substitution of his platinum of a filament of carbon the success he had long sought for would not then have been obtained.

The second claim of the patent is broad enough in its phraseology to cover the invention above set forth—at least when the burner is a carbon *filament*. This last word is not specifically defined in the patent, though therein it appears for the first time in the art. It was a common English word with a meaning sufficiently plain to indicate that the cross section of any article which it was used to qualify must be so small as to be threadlike; and we think a sufficient indication of what that size is would be afforded by an examination of the ordinary threads in common use.

An examination of the patent, however, indicates its dimensions with more exactness. It is to be fragile, so small in cross sections that, with earlier carbon rods, its use is a "reversal of former practice." One of the substances suggested in the patent to be used as a burner is to be reduced to .007 of an inch in diameter. Ordinary cotton thread, also suggested in the patent, has varying diameters, the largest commonly used being $\frac{1}{21}$ of an inch in diameter; the Patent Office model has a diameter of about $\frac{1}{42}$ of an inch. The evidence fails to satisfy us that the prior art furnished any burners less than twice this size.

In contradistinction to these earlier burners Edison called his burner a *filament*. The term is apt and we do not think he was required to specify by thousandths of an inch its precise maximum and minimum. Surely no one could doubt that burners nearly approaching in size the examples of his filament shown in the patent would be filaments, nor that burners nearly approaching in size the earlier of the rod burners would be rods. The defendant's burners are smaller in cross-sections of the carbon thread of the Patent Office model and indisputably lie wholly on one side of the dividing line between rods and filaments, which therefore for the purposes of this suit need be more closely defined. The carbons which defendant operates in a high vacuum in all glass chambers with platinum wire sealed in, and which by such method are not exposed to air-washing are thus rendered practicably stable, are filamentary in size and therefore *filaments* within the meeting of the second claim, unless that word is to be qualified as before suggested. That it is to be so qualified by importing into it "coiling" of the burner is unwarranted in view of the fact that the patent refers to both coiled and uncoiled threads, and the third claim specifically covers the coil form. The first claim is a comprehensive one intended to include, and by its use of the words "made as described" in fact including the invention as the draughtsmen understood it—to wit: the burner which was to subdivide the electric light by its ratio of resistance to radiating surface and also the subsidiary inventions (1) of coiling, when desired, either as effecting the ratio or as a protection against flickering; (2) of securing the burners to the wires; and (3) of providing a place for its operation, to wit: the exhausted all-glass globe which would secure practical stability. To cover each of these inventions a separate specific claim is made and the second claim seems clearly intended to cover the combination of parts to secure the stability of the cover, irrespective of the fact whether it is coiled or uncoiled, is clamped to the leading-in wires or secured by the plastic combination of the fore claim is made out of one or other of the varieties of the carbons mentioned in the patent, or even out of some other known variety not mentioned, irrespective also of the fact whether its resistance is higher or lower except so far as the *filamental* character and its designed function would determine the measure of that resistance. This conclusion seems plainly indicated by the peculiar phraseology of the claim. It is for "the combination of carbon filaments with a receiver made entirely of glass, etc., and from which the air is exhausted for the purpose set forth;" that is, for the purpose of preventing a disintegration of the burner resulting from air washing. All the experts and all the counsel agree that the words "carbon filaments," because the combination of the patent contemplated only the incandescence of a single filament in each lamp. This is correct, but the words thus altered found their place in the claim through no mere clerical error. Maps, though they may be to describe the individual concrete combinations, which were to be protected against infringement, they are illuminative of the efforts of the draughtsman to secure his exhausted all-glass receivers in combination with carbon filaments of all kinds, and he used the plural, omitting the phrases "of high resistance" and "made as described," used in the first claim in order to make sure that he should not, as to this second claim, be confined by construction to any one variety of filament. For this reason the future limitations, which defendant seeks to read into this claim, viz.: That the filament must be one of high specific resistance, or of, at least, 100 ohms resistance, cannot be accepted.

The second claim may be thus paraphrased.

The combination of carbon, filamentary or thread like in size and properly carbonized, used as an illuminant in an incandescent electric lamp with a receiver made entirely of glass and conductors passing through the glass, and from which receivers the air has been exhausted to such an extent that disintegration of the carbon, due to the air washing action of surrounding gases or to any other cause is so far reduced as to leave the carbon practically stable.

Defendant's lamps are plainly infringements of the second claim as thus construed.

Defendant further contends that the patent is invalid because it does not so describe the lamps as to enable a person skilled in the art at the date of the patent to make a practically useful structure. The evidence of the witness Howell seems to us a conclusive answer to this contention. He made, as he testified, according to the directions of the patent, and using only processes known to the art before its date, incandescent lamps such as the patent describes, which lasted 600 hours. Defendant criticises this evidence because the witness subjected the filaments made by him to the action of the electric current during the process of exhaustion. But the patent repeatedly directs that the vacuum shall be high and nearly perfect. Sawyer and Man had, prior to the date of the patent, shown that there were occluded in the carbon itself, and in the various internal parts of lamp chambers, gases and impurities, which are set free by the passage of the current. Manifestly, if they were not removed before sealing, the nearly perfect vacuum would soon disappear. Edison's French patent also details a process for forcing them out of platinum and removing them while exhausting is going on, and a person, who was sufficiently skilled in the art to know of these earlier publications, and was carefully solicitous to conform to the directions of the patent would naturally have resorted, as Howell did, to this method to secure a vacuum free, so far as might be, from the intrusion of such occluded gases. It is contended, however, that this process of "electric heating on the pumps" in effect produces a carbonization of the filament, that it is now used as a part of the process of carbonization, and that, therefore, because the patent simply directs that the filaments be "properly carbonized," because electrical heating is now used with the understood object of supplementing the work of the carbonizing furnace, because Edison has always thus heated his filaments, and because such additional carbonization is necessary to make a practical lamp under his patent; therefore, he has either purposely suppressed an essential element of his process, or has failed to give the full, clear and exact description of it which the statute calls for. To this proposition we cannot consent. It is immaterial that the philosophy of electric heating on the pumps is better understood to-day than it was in 1879, so long as the requirements of the patent would not be complied with by one skilled in the art, unless he did in fact so beat the filaments. Whether he heated to carbonize or to secure a nearly perfect vacuum, the result would be the same—an operative lamp produced by following the directions of the patent with the ordinary skill of the art, and that is all the patentee was required to show.

The other defenses interposed by defendant may be more briefly noticed.

The patent in suit was issued Jan. 27, 1880. A patent for the same invention was issued in Canada, Nov. 17, 1879, No. 10,654, the term of which, expressed on its face, was five years; but the Canadian statute gave to the owner of the patent the right to an extension at his option, in the payment of a required fee, for the further period of ten years. On May 4, 1883, the owner paid the fee required, and on Oct. 30, 1883, obtained certificate of extension. In Bate Refrigerating Company v. Hammond, 129 U. S., 164, it was held that, so far as the term of a Canadian patent, thus extended under the Canadian statute operated to curtail the term of a United States patent or under Section 4,887 U. S. Rev. Stat., it would be regarded as a continuous term for the entire period.

It appears, however, that on March 5, 1880, a patent for the same invention was granted in Sweden, the grantee of which subsequently failed to prove, as required by the law of that country, that the invention was "being constantly practiced within the kingdom." Thereupon, on March 5, 1883, the Swedish patent right was lost and forfeited. Defendant contends that in consequence the Canadian patent expired on the same day March 5, 1883, or if continued to expiration of the first five years expressed on its face, viz.: Nov. 17, 1884, it could not by the payment of fees, or the certificate of the Canadian Commissioner of Patents, be extended for an additional ten years. For that reason defendant contends that the case at bar is distinguishable from Bate Refrigerating Company vs. Hammond, and that the patent in suit expired with the Canadian patent either on March 5, 1883, or Nov. 17, 1884, prior to the beginning of this action.

The Canadian statute provides as follows:

"An inventor shall not be entitled to a patent for his invention if a patent therefor in any other country shall have been in existence in such country more than twelve months prior to the application of such patent in Canada, and if during such twelve months any person shall have commenced to manufacture in Canada the article for which such patent is afterward obtained, such person shall continue to have the right to manufacture and sell such article notwithstanding such patent, and under any circumstances, when a foreign patent exists the Canadian patent shall expire at the earliest date at which any foreign patent for the same invention expires."

The soundness of the defendant's contention depends on the meaning under Canadian law of the phrase "where the foreign patent exists" as used in this statute. If that phrase is confined to foreign patents which exist before the relevant Canadian patent as issued, the loss and forfeiture of the Swedish patent right in no way affected the Canadian patent to Edison. The meaning of this phrase has not been declared by the Canadian courts, but a careful examination of the evidence given by the Canadian lawyers who had testified as to its practical construction by the Canadian government, and had given their professional opinions as to its meaning in Canadian law, satisfies us that it is there used as covering only foreign patents which exist before the issue of the relevant Canadian patent. We are of the opinion, therefore, that neither directly (Pohl vs. Anchor Company, 134 U. S., 381), nor indirectly through the Canadian patent, is the patent in suit affected by what happened to the Swedish patent.

The failure to limit the patent in suit on its face to a shorter term than 17 years, so as to expire at the same time with the foreign patent having the shortest term, does not affect its validity (Bate Refrigerating Co vs. Hammond, 129 U. S., 151), nor do we think that validity is in any way affected by the attempted certificate of correction, the patent as regularly issued being in every respect a regularly executed documents, and the statute providing for no subsequent attention thereof by the Patent Office (except in cases of reissue, which this is not), the action of the Commissioner in indorsing it with an attempted "correction" was without jurisdiction and wholly void. And in the absence of any provision of law contemplating the surrender of an original patent by the grantee or holder (except for reissue) we cannot find, in the request to have such unauthorized correction made, any reason for holding that the patent was, by that act, surrendered. It is further urged by the defendant that the suit abated on Dec. 31, 1886, by reason of the dissolution of the complainant consequent upon its merger, at the date named, in the corporation "Edison Electric Light Company." Except for the statute of the State of New York permitting consolidation, the original companies could not have thus merged themselves into a new corporation. The State, which thus provided for the consolidation of the creatures of its own creation, undoubtedly had the power to regulate the manner of that consolidation and the extent to which the functions, inherent in their former life, should be thereby suspended or destroyed. Among those functions was the conducting of suits, actions and proceedings in courts of justice. The right to appear as a party litigant was one which the corporation or artifical person obtained by the act of the State which created it, and it certainly has never been contended that because that creation was under State law, such artificial person could not be a party litigant in federal courts. When the State undertook to regulate the matter of consolidation, and the extent to which it should terminate the life of the artificial persons it had created, by destroying their functions, it expressly provided (Laws of New York, Chap. 367 of 1884, Sec. 6) that "no suit, action or proceeding then pending before any court or tribunal, in which any corporation that may be so consolidated is a party, or in which any such stockholder is a party, shall be deemed to have abated or been discontinued by reason of any such consolidation; but the same *may be prosecuted to final judgment in the same manner as if the said corporation had not entered into the said agreement of consolidation;* or the said new corporation may be substituted," etc.

The State by this act expressly avoided interfering with the continued exercise of the artificial person's functions as a litigant, in cases when such functions were already in use. Therefore, being properly a party litigant in this suit before consolidation, it would remain so afterward, not because the State is operative to regulate the practice and procedure of federal courts in equity suits, but because, so far as the litigant life of the artificial person—properly a party to the suit, when brought—is concerned, there has been no change, the only power which could destroy it having scrupulously refrained from doing so. As by the consolidation all the property and rights of the old company were transferred to and vested in the new (Consolidation Act, *supra*, Sec. 5), and the new company succeeded to all the obligations and liabilities of the old one, the fruits of any recovery belong to the new company, and the provisions of diverse judgment can be enforced only against it.

The survival proposed by pending statutes is, therefore, merely nominal, but that is no anomaly. Provisions of law allowing personal representatives to continue suits in the name of original party after his death are common.

Nor do we find any bar to the continuance of this suit in the provisions of Sec. 4,889 U. S. Rev. Stat., that "every patent or interest therein shall be assignable in law by an instrument in writing," whether the legal right to the patent in suit passed with all beneficial interests in the patent by the consolidation to the new company, or whether some instrument in writing must still be executed to make such transfer complete. And although the old company continue sufficiently to consummate the devolution which the Consolidation Act provided for (see Edison Electric Light Co. vs. New Haven Electric Co. 35 Fed. Rep., 236) the new company would have the right to continue under the name of the old one pending litigation to enforce rights, which are, in fact, its own, with the same force and effect as if it were its complainant. We do not find in the various contracts introduced in evidence sufficient warrant for holding that the complainant was without such interest in the subject of the controversy as to enable it to maintain the bill in its own name without joining other parties nor do the facts make out such a case that injunction should be revised on any of latches or equitable estoppel by reason of undue delay in bringing suit, all acquiescence under infringement.

The decree of the Court is, therefore, affirmed with costs.